Special Hybrid Maize Issue

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OUR COVER—Exceptionally vigorous and high yielding, hybrid maize is a remarkable gift of science to India's agriculture. Hybrid maize cultivation will bring great prosperity to our farmers, and will help win the country's battle on the food front.

FARM INFORMATION UNIT
DIRECTORATE OF EXTENSION, MINISTRY OF FOOD AND AGRICULTURE, GOVERNMENT OF INDIA, NEW DELHI

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A SURE WAY OF PRODUCING MORE FOOD

THE evolution of HYBRID MAIZE is an outstanding achievement in the practical application of the Science of Genetics to agriculture. Its development has changed the entire agricultural economy of the U.S.A., and progressive countries all over the world have taken to its cultivation for increasing the production of foodgrains. In our country the cultivation of hybrid maize offers one of the surest means of increasing the foodgrain production.

Though maize figures as an all-India *kharif* crop with an acreage of 9.5 million, its yield per acre is extremely low and is only one-third of that in the U.S.A. One of the main reasons for this low yield is the lack of quality seed, and the solution is now offered by the evolution of the hybrid maize varieties in India. It has now been conclusively proved through pilot experiments and demonstrations that the yield from hybrid maize can in certain cases be nearly double of what is obtained from local varieties.

Our research workers in collaboration with the Rockefeller Foundation have developed maize hybrids suited to the different regions of the country, and within a short period of their release, these hybrids have gained popularity among progressive farmers. If the present rate of progress can be maintained, we are sure to achieve the target of putting a large portion of the maize acreage under hybrid maize by the end of the Third Five Year Plan.

The use of hybrid seed alone will not achieve increased production. All the recommended agronomic practices have to be followed for obtaining the maximum yield from these hybrid varieties. I welcome this Special Number of INTENSIVE AGRICULTURE which brings to the farmer all the necessary information on the cultural and manurial practices connected with the cultivation of hybrid maize all over the country.

S. K. Patil

Minister for Food and Agriculture

Hybrids mean more yield, more profit

By A. D. Pandit

MAIZE is an important minor cereal of India, and is grown in all parts of the country mainly as a *kharif* crop. It occupies nearly 9.5 million acres of the cropped area, but the total annual production is only 2.9 million tons. Thus the average yield per acre is 8.5 maunds which is about one-fourth of the average yield in Western countries.

The same is the position in respect of all other crops. This is largely because the great advances made in the science of agriculture in Western countries during the last 50 years have made little impact on the agricultural practices followed by the majority of our farmers.

Many spectacular improvements have been brought about by plant breeders in different crop plants by the application of the science of genetics. The exploitation of hybrid vigour in some crops has indeed been the greatest landmark in the field of crop improvement.

The most outstanding work in this field has been done in the case of maize in the U.S.A. in the 'thirties.' The procedure followed was to select two pairs of carefully selected inbred-lines and to produce two single crosses out of them. From the two single crosses, the double cross was produced. The seed of this double cross yielded a vigorous crop with a fine stand, the produce of which was about 30 to 40 per

cent more than that of the ordinary maize. Today nearly 95 per cent of the maize acreage in America is under hybrid varieties.

Research work to develop suitable hybrids of various crops for our different soil and climatic conditions has been going on at our plant breeding stations for some years. Hybrids of wheat, rice and other crops, possessing disease-resistance or other desirable characters, are widely spread. The work on hybrid maize was first taken up in a small way in 1945. It was not, however, until the initiation of the coordinated maize programme in collaboration with the Rockefeller Foundation who brought in from the U.S.A. some of the most distinguished agricultural scientists to work with their Indian counterparts, that the programme really got under way.

The release of four hybrids which are named *Ganga 1, Ganga 101, Ranjit* and *Deccan* for commercial production to farmers in the northern plains and peninsular India, has been a remakable achievement. One of the advantages of hybrid maize is that it requires a seed-rate of about 12 to 15 pounds per acre as against 20 pounds for the local maize varieties, and yet the yield is much greater owing to the larger number of cobs per plant and the fully covered cob with bold and heavy grain. More recently a variety suitable for the hill regions has also been released.

The advent of hybrid maize in the countryside is laying the foundation of a private seed industry for food crops, which we have so far lacked. Production of hybrid maize requires special care and frequent inspection, precaution to avoid cross-pollination from local unimproved varieties, detasseling the parent to be used as the female before it can shed its pollen, adequate manuring, timely irrigation, etc. As this is a specialized job, only progressive cultivators who can understand the technique of hybrid seed production and are prepared to give all the necessary care and attention, can engage in the production of hybrid maize seed. The seed is produced under the supervision of experts of the Indian Council of Agricultural Research and the Rockefeller Foundation, and is certified as to its purity and viability. It naturally fetches a good price and thus provides adequate incentive for production of pure and viable seed.

These hybrids have been released after extensive trials and demonstration in different parts of India. Hybrid maize can stand larger doses of fertilizers without lodging and can produce more grain as well as fodder. In these trials hybrid maize has given yields about 30 to 40 per cent greater than those of local varieties under identical conditions of soil, irrigation, manuring, etc.

The hybrids have given excellent performances in trials all over the country

In these trials it has been proved that even with the best agronomic practices, local varieties of maize cannot yield as much as hybrid maize does. It would, therefore, be an advantage, when we are engaged in improving our agricultural practices, to change over to hybrid maize to get the maximum benefit of the combined use of good seed and sound agronomic practices.

Hybrid maize finds wide uses in the adhesive paper and textile and chemical industries. In the West, most of the produce is utilized as livestock feed or in industry. It has not been possible to use maize in industry in India or as livestock feed on any substantial scale because we have been short of food. If owing to extensive use of hybrid maize our production goes up substantially, more and more of it can be diverted to industry. Hybrid maize will then, unlike local maize, become both a food and a commercial crop and will thus assure the cultivator of an adequate outlet for his increased production and a stable price.

WHY YOU SHOULD GROW HYBRID MAIZE

By T.R. MEHTA

WHY should you grow hybrid maize? The answer is simple.

Because it is much more profitable for you to grow hybrid maize than the local varieties. Or in other words, the yield from hybrid maize is so high as to leave you a much bigger margin over the cost of production.

Producing larger yields of hybrid maize, no doubt, requires a larger effort and larger investment. But the results are worth this effort and investment. The yields are sufficiently profitable for you to have the incentive and the urge to put in the effort and money involved in growing hybrid maize.

The ordinary varieties of maize are known to give large yields if grown under sound agronomic practices. Plenty of manure, judicious use of fertilizers, timely planting, proper spacing of plants—all these go to ensure high yields. To the extent higher yields mean more profit, you would certainly take care to use these means of raising good crops of maize.

But you would not look upon maize cultivation as an activity isolated from your farming unit as a whole. The amount of manure and fertilizers which you employ for raising a good crop of maize, would mean so much of resources denied to other crops. So you have to think out the answer to the question: 'are these resources best utilized on maize or on wheat or cotton?' Evidently, you would decide to utilize them on crops which will bring you the best returns.

The ordinary varieties of maize do not offer you the best chances of getting high returns from the resources which you put in. The increase in yield is not large enough to induce you to give a high priority to investing on maize.

At the level of soil fertility at which the maize crop is now grown by the majority of farmers in India, the yield averages 350 to 400 kilograms per acre. Judicious manuring helps the yields to go up to two and even two and a half times this average yield. Beyond a rather modest level, however, the ordinary varieties of maize fail to give attractive return on further investment, and so you would wisely decide to limit your investment and effort to a modest level. Beyond this, the game would not be worth the candle.

But with hybrid maize having a higher yield potential, it is possible for you to get attractive returns up to much higher levels of investment, thus making it worth your while to put in larger investment by way of better agronomic practices and application of manures and fertilizers.

You may ask "why does hybrid maize have a higher yield potential?" You may as well ask "why does the race horse run faster than an ordinary horse?" The answer is : because it is built that way; because it was selected from amongst a large number of hybrids, on account of its high-yielding ability.

Selection among the ordinary (open-pollinated) varieties of maize has given a number of good, high-yielding varieties. The plant breeders have produced, by scientific use of many of these varieties, hybrid maize varieties which have enabled maize to yield higher than had been possible through all other methods of breeding of maize.

That hybrid maize can yield larger crops and bigger profits, has been amply demonstrated with the new maize hybrids developed in the last few years in India—*Ganga 1*, *Ganga 101*, *Ranjit* and *Deccan*.

In twenty demonstrations conducted in the Punjab last year, the yield of *Ganga 101* was 39.0 maunds per acre as compared to 26.4 maunds of local maize grown according to recommended practices. These yields represent an increase of 20.3 and 7.7 maunds, respectively, over the yield given by the local variety grown according to the local practices (which is 18.7 maunds).

The return from hybrid maize was more than two and a half times as compared to the return from the use of local seed, even when the extra expenditure on the costly hybrid seed is taken into account. Thus the higher expenditure on buying hybrid seed for sowing is fully justified by the results.

The extra cost of hybrid seed comes to a mere four to five rupees per acre, which represents a very small fraction of the total cost of production. But it gives an additional profit of more than Rs. 200 per acre.

The results from demonstrations conducted in Madhya Pradesh, Rajasthan and Gujarat are even more impressive.

In the 56 demonstrations conducted in five States (Punjab, Delhi, Madhya Pradesh, Rajasthan and Gujarat), the average increase in yield over the present local average was 25 and 9 maunds per acre, respectively, for the hybrid maize and the local maize, both grown under recommended practices.

The next question is : what are the recommended practices, and how much more (or less), as compared to the local practices, do they cost you to adopt them? These are :

1. Deep ploughing (six to eight inches) and good seed-bed preparation.
2. Use of compost.
3. Line-sowing in 24, 30 or 36-inch rows, to attain about 20,000 plants per acre.
4. Sowing at the proper depth (one inch to two inches).
5. Use of adequate fertilizers. For the demonstrations, the amounts recommended were N 100 pounds, P 60 pounds, and K 30 pounds; 30 pounds N and all the P and K were to be applied at the time of sowing 1 inch below and 2 inches to one side of the seed, and 40 pounds N applied as a top-dressing when the crop is 18 inches high and 30 pounds at blooming time.
6. Complete control of weeds.
7. Provision of adequate irrigation and drainage.
8. Control of pests.

How much more (or less) these practices will cost you, would depend upon what your present practices are.

In Rajasthan it appears that the local practices, as followed in Udaipur where the demonstrations were conducted, are almost as good as the recommended practices. They may represent the same level of inputs or investment. In the other regions the recommended practices appear to represent higher levels of inputs than the local practices.

If we assume that in the local practices no fertilizers are used, then the recommended practices will represent an additional investment of about Rs. 150 per acre. If with this additional investment the local variety gives an increase of 9 maunds per acre, it is evident that no farmer will find it profitable to use the recommended practices. Most farmers would limit their input to much less, where it is remunerative. On the other hand, the increase of 25 maunds per acre, given by the hybrid maize, is sufficiently attractive to encourage the farmer to increase his inputs, thus increasing the output of his crop and his profits.

The average increase of 25 maunds per acre does not show a complete picture of the profits from hybrid maize. This average increase covers a range of increased yields from about ½ maund to over 50 maunds per acre. You can imagine the margin of

profit in the case of the yield increasing towards the higher extreme, and this from a crop which occupies the field for only about 3½ months.

Such an increase in yield has not been possible with the local maize varieties. It may not be possible with most other crops grown by the farmer. This will help many a farmer to realize, as never before, how profitable improved agronomic practices can be and the lesson learnt and the profits gained from hybrid maize may go a long way in breaking him loose from traditional thinking and practices, and start him on to the path of scientific and commercial farming.

Apart from the profits which the high yield potential of hybrid maize makes it possible for you to secure from the maize crop, the improved practices would help the following crop to enjoy better conditions of growth and thereby produce higher yields. In other words, the recommended practices relating to hybrid maize would have their residual effect upon the crop that would be grown after maize in the same field.

When all these benefits can result from the growing of hybrid maize, why not then grow it ?

For Certified Hybrid Maize seeds

Ganga No. 1 and 101 :

Please contact

Messina Joint Farming Cooperative Society Ltd.

Moh. Kashipur.
P.O. SAMASTIPUR
Distt. Darbhanga

Telegram : MISRA

Telephone : SAMASTIPUR 13

Increase your profits by using Hybrid Maize Seed.

Use hybrid maize seed and be in the front row with fighters on our country's food front.

Maize can be used in industry for the manufacture of over 500 products.

For every pound of nitrogen applied to hybrid maize you may expect 25 pounds of extra grain at harvest.

The ICAR CERTIFICATION 'TAG and SEAL' on the bag of seed assures the purchaser that the seed is as the label indicates.

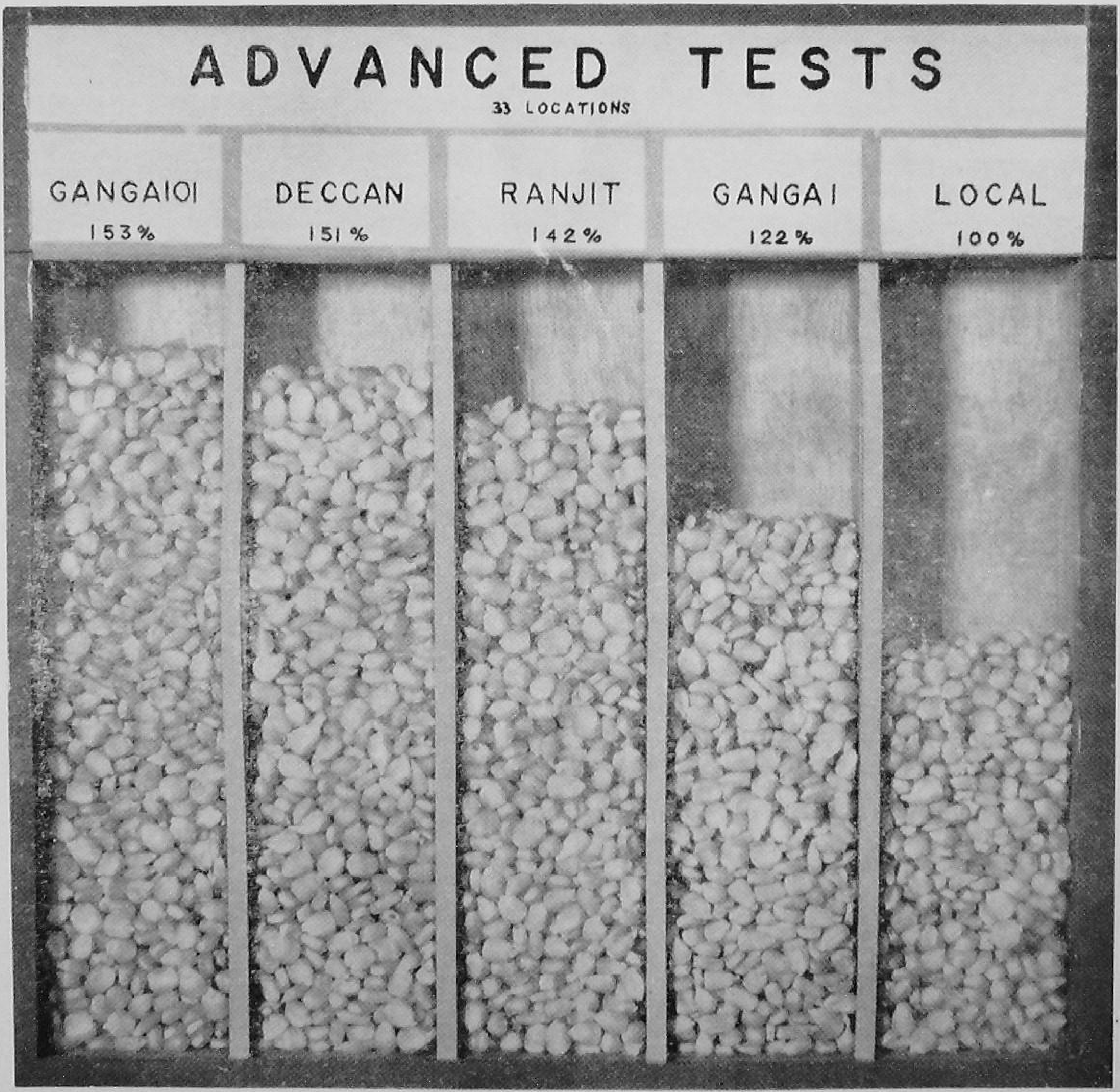
TRIALS PROVE HYBRIDS PAY MORE

By N. S. GILL and G. V. CHALAM

THAT hybrid maize yields higher than local varieties has been proved in trials under Indian field conditions. It is also paying to invest in the growing of hybrid maize. This is proved by the following facts and figures.

These figures are based on the average performance of the four hybrids under advanced trials conducted under the coordinated maize breeding scheme during *kharif* 1961 over 37 locations throughout India.

In the trials, two levels of nitrogen—low level of



40 pounds N and high level of 100 pounds N per acre—were tried with a uniform dose of 80 pounds of phosphate (P_2O_5) and 40 pounds of potash (K_2O) per acre in each plot. The average yields of the hybrids and the local variety, obtained at the two fertility levels, are given below :

	Average yields in maunds per acre (at 15 per cent moisture)	
	Low fertility	High fertility
Ganga 1	28·3	34·9
Ganga 101	35·7	44·0
Ranjit	31·9	39·5
Deccan	33·7	41·9
Local	25·6	28·7

If the above figures are compared with the all-India average yield of 10 maunds per acre of maize, it will be evident that our farmers can make a substantial increase in their production by growing hybrid maize.

Considering that the average yield of 10 maunds is obtained without the use of fertilizers, the additional cost of cultivation of hybrid maize (in the form of extra cost on seed and the cost of fertilizers) would be as folows :

Lower fertility level :

	Figures in Rs.	
	Local	*Hybrids*
Additional cost of seed	—	6
Cost of 40 pounds N	32	32
Cost of 80 pounds P_2O_5	50·40	50·40
Cost of 40 pounds K_2O	11·20	11·20
TOTAL	93·60	99·60

Higher fertility level :

	Figures in Rs.	
	Local	*Hybrids*
Additional cost of seed	—	6
Cost of 100 pounds N	80	80
Cost of 80 pounds P_2O_5	50·40	50·40
Cost of 40 pounds K_2O	11·20	11·20
TOTAL ..	141·60	147·60

Taking the price of maize to be Rs. 12 per maund, the national gross income per acre of maize works out at Rs. 120. With hybrid maize grown at low fertility level of 40 pounds of nitrogen per acre, the additional net income per acre to the farmer would be as follows :

Variety	Yield per acre (*Maunds*)	Gross value at Rs. 12 per maund (*Rs.*)	Additional cost of cultivation (*Rs.*)	Additional net income per acre (*Rs.*)
Ganga 1 ..	28·3	339·60	99·60	120·00
Ganga 101 ..	35·7	428·40	99·60	208·80
Ranjit	31·9	382·80	99·60	163·20
Deccan	33·7	404·40	99·60	184·80
Local	25·6	307·20	93·70	93·60

Since these hybrids have been evolved for high fertility conditions, their yield potential will not express itself fully on a low level of nitrogen application. From the figures given below it can be seen that the net additional returns from the hybrids can be considerably increased at the high level of nitrogen fertilization.

Variety	Yield per acre (*Maunds*)	Gross value at Rs. 12 per maund (*Rs.*)	Additional cost of cultivation (*Rs.*)	Additional net income per acre (*Rs.*)
Ganga 1 ..	34·9	418·80	147·60	151·20
Ganga 101 ..	44·0	528·00	147·60	260·40
Ranjit	39·5	474·00	147·60	206·40
Deccan	41·9	502·80	147·60	235·20
Local	28·7	344·40	141·60	82·80

It is evident that the highest economic returns from the hybrids are obtained with a high level of fertilizer application. It is also apparent that the yield potential of local maize is very limited with the result that it is uneconomical to apply high doses of fertilizers. The highest economic return of local variety is at 40 pounds of nitrogen per acre.

Hybrid maize has brought about a revolution in agriculture and industry of the U.S.A. Its cultivation offers an opportunity for our farmers to increase their income and raise their standard of living.

WHAT DEMONSTRATIONS SHOW ABOUT HYBRID MAIZE

By L. M. HUMPHREY

HYBRID maize is new and high-yielding, and is being introduced to the Indian farmer. Its wide use and proper cultivation can make a very substantial contribution to the urgently needed expansion in supplies of food. Good maize hybrids have been developed by the Indian Agriculutral Research Institute working with the technicians of the Rockefeller Foundation.

Field demonstration is recognized as one of the most effective ways to convince the farmers of the advantages to be gained by adopting new things in agriculture. This is true whether the new thing be the use of fertilizer, use of new implements, better cultural practices or the use of improved seed of new high-yielding crop varieties.

At the request of the Government of India, the United States Agency for International Development has undertaken to assist the State Agricultural Extension agencies in carrying out field demonstrations to show the advantage of using this new type of maize.

The programme in 1962 was so designed that a few well-conducted, relatively simple demonstrations could be conducted in selected districts. In this way, a closer supervision could be given than would have been possible with a large number of widely scattered locations.

The locations of demonstrations and the hybrid or hybrids used are shown below :

State	Districts	No. of Demonstrations	Hybrids
Andhra Pradesh	Warangal	5	*Deccan*
	Karimnagar	4	*Deccan*
Bihar	Darbhanga	10	*Ganga 1* and *Ganga 101*
Gujarat	Panchmahals	10	*Ranjit*
Maharashtra	Kolhapur	10	*Deccan*
Mysore	Dharwar	7	*Deccan*
	Belgaum	6	*Deccan*
Madhya Pradesh	Jabalpur	10	*Deccan* and *Ganga 101*
Punjab	Ambala	10	*Ganga 101* and
	Ludhiana	10	*Ganga 1*
Rajasthan	Udaipur	10	*Ranjit*
Uttar Pradesh	Meerut	5	*Ganga 101* and
	Bulandshahar	5	*Ganga 1*
Delhi	3 Blocks	10	do.
Himachal Pradesh	Sirmur	3	do.
Madras	Coimbatore	3	*Deccan*

The yield levels attained in the Punjab demonstrations : (from left to right) *local maize with local practices; local maize with recommended practices;* Ganga 1; Ganga 101

The stand of the hybrid crop (right) *was markedly superior to that of the local* (left)

This makes a total of 118 demonstrations started.

It should be remembered that the purpose of a demonstration is to *show* a fact or facts already known. If this is not done, then the demonstration is a failure, and is much worse than none at all.

The following design was used in all demonstrations :

Plot 1	*Plot 2*	*Plot 3*
Local variety of maize with local cultural practices	Local maize with recommended cultural practices	Hybrid maize with recommended practices

In the districts where two hybrids were used, an extra plot was added. The size of plots varied from 1/8 to 1/4 acre. The only requirement was that all the three plots (or four in some cases) were identical in size. The recommended practices included the following :

1. Deep ploughing (six to eight inches) and good seed-bed preparation.
2. Use of compost.
3. Line-sowing in 24, 30 or 36-inch rows to get about 20,000 plants per acre.
4. Sowing at proper depth (one to two inches).
5. Use of adequate fertilizers. For the demonstrations the amounts recommended were N. 100 pounds, P 60 pounds and K 30 pounds. Thirty pounds of N and all the P and K were to be applied at the time of sowing one inch below and two inches to one side of the seed, and 40 pounds of N applied as a top-dressing when the crop was 18 inches high and 30 pounds at blooming time.

6. Complete control of weeds.

7. Provision of adequate drainage and irrigation.

8. Control of pests.

All the eight practices were followed.

The demonstrations were conducted in 12 States, but just now the results from only 6 States are available. These show clearly the superiority of two things :

1. The value of good farming methods.

2. The superiority of hybrid maize over local varieties.

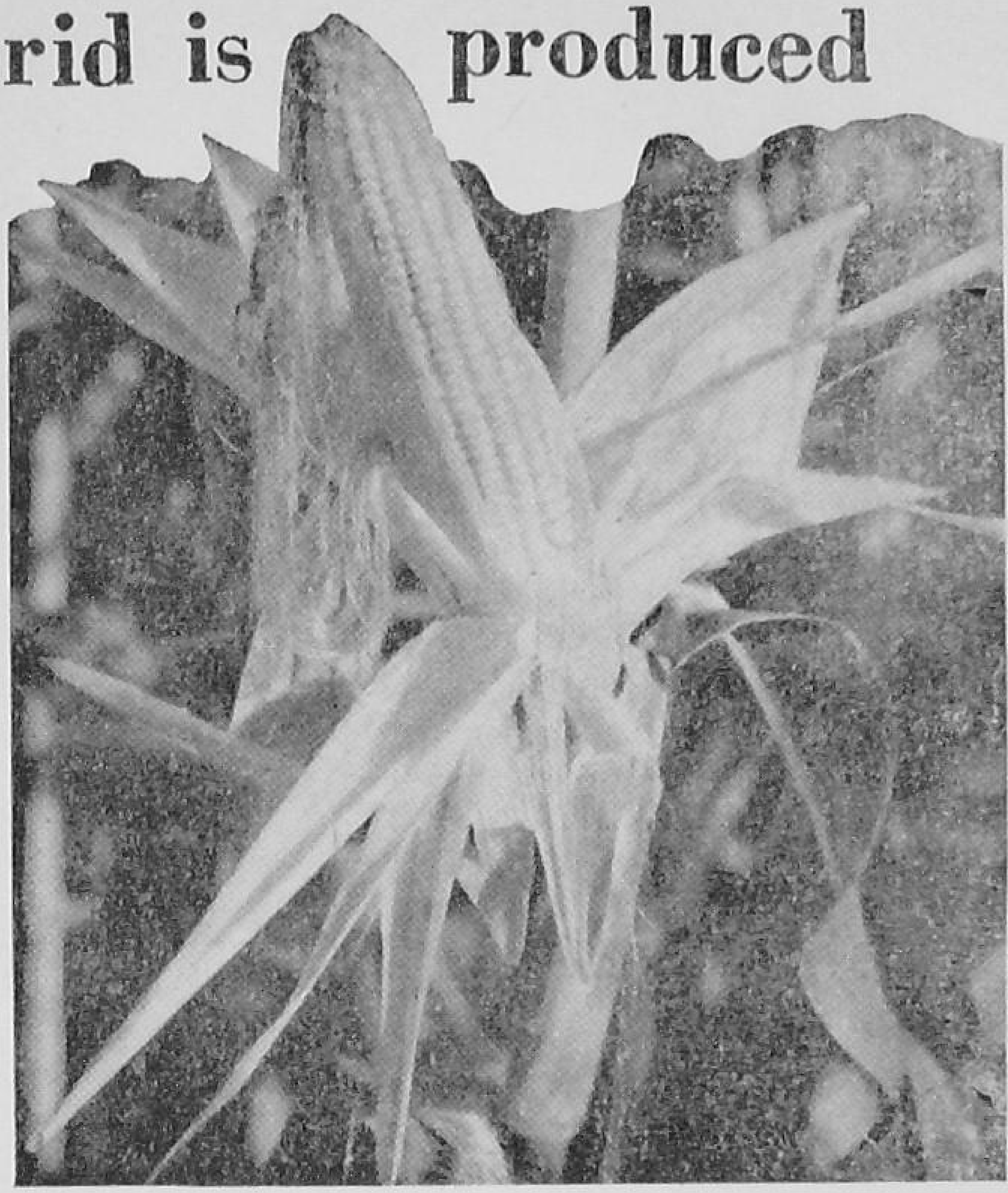
In the Punjab and Rajasthan, there are not many differences between the local and recommended practices, as in these areas the farmers normally use considerable amount of fertilizers. Also, in many cases, the sites chosen for demonstrations were of above-average fertility.

Broadly speaking, the results of these demonstrations show that :

- Hybrid maize has the ability to out-yield local varieties by a substantial and frequently quite a large quantity.
- The use of hybrid maize seed along with good farming practices including the use of sufficient fertilizers, can increase the quantity of maize produced by two to several times, and will not only increase the country's food supplies but will obtain for the farmers a good profit in the process.
- The local varieties do not have the ability to respond to high levels of fertility, as do the hybrids.
- Investing in good hybrid maize seed and sufficient fertilizer is a sound policy for the farmer and for the country.

The hybrids had more vigorous plants with more of leafy growth, fewer barren stalks, and cobs with a good husk cover

How a Hybrid is produced



To obtain hybrid seed with extra vigour, special techniques are employed by scientists

By V. M. SAHNI
W. H. FREEMAN and
G. W. ERION

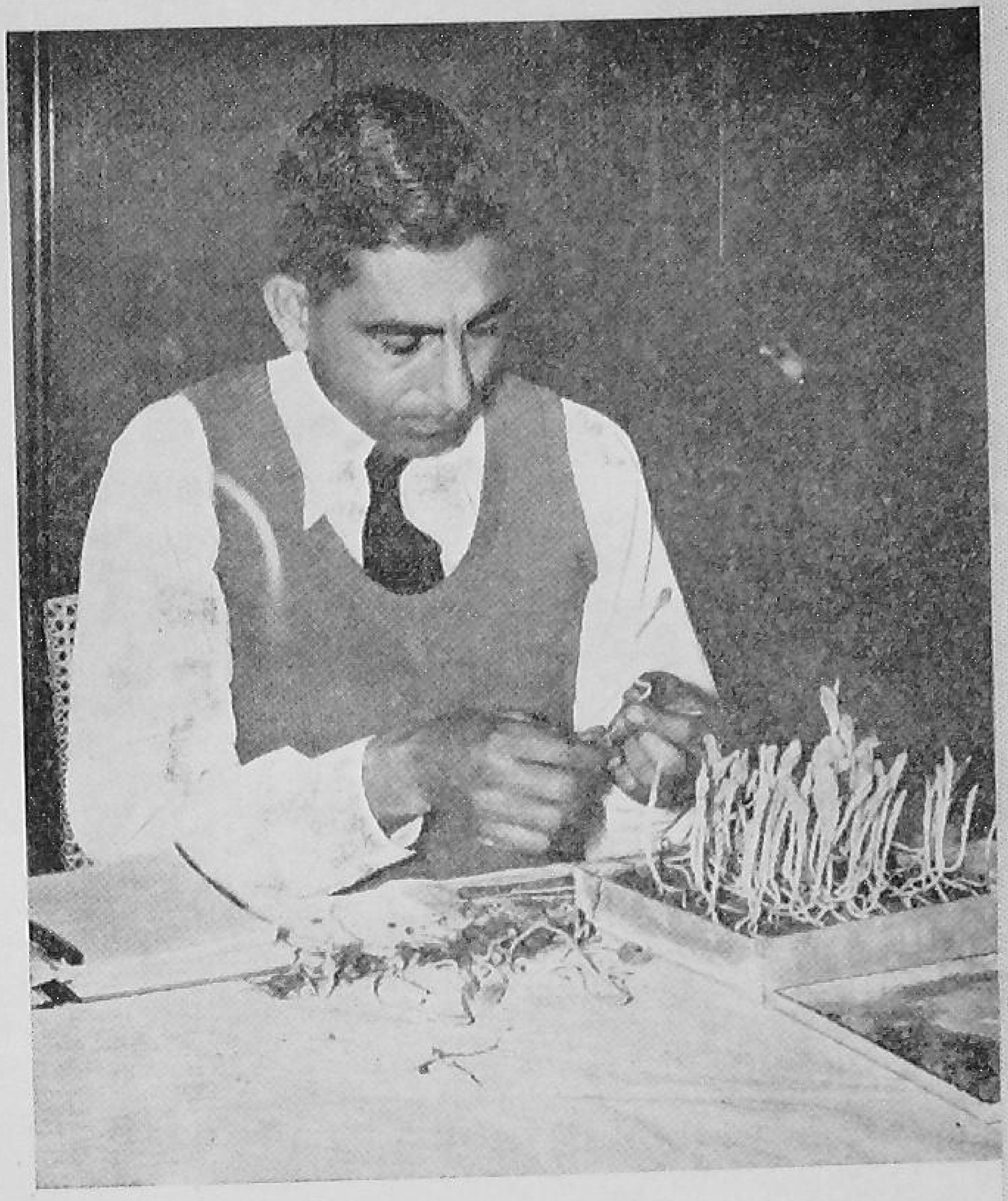
HYBRIDIZATION of maize enables the cultivator to obtain seed of a type which shows extra vigour and gives more production over either of its parents. Whereas seed produced on unreliable inbred parents gives low yield.

Hybridization of maize, however, requires a good amount of special knowledge and techniques.

To make hybridization an economic reality, it is necessary that the double cross be discovered. This done, production of seed in quantities and at prices economical to the cultivator becomes feasible. With the double cross, i.e. the cross of two unrelated single crosses, the inbred parents become the grand parents of the seed which the cultivator plants.

The unique system of producing seed on only a portion of the maize plants grown in a field requires an entirely different concept in seed production.

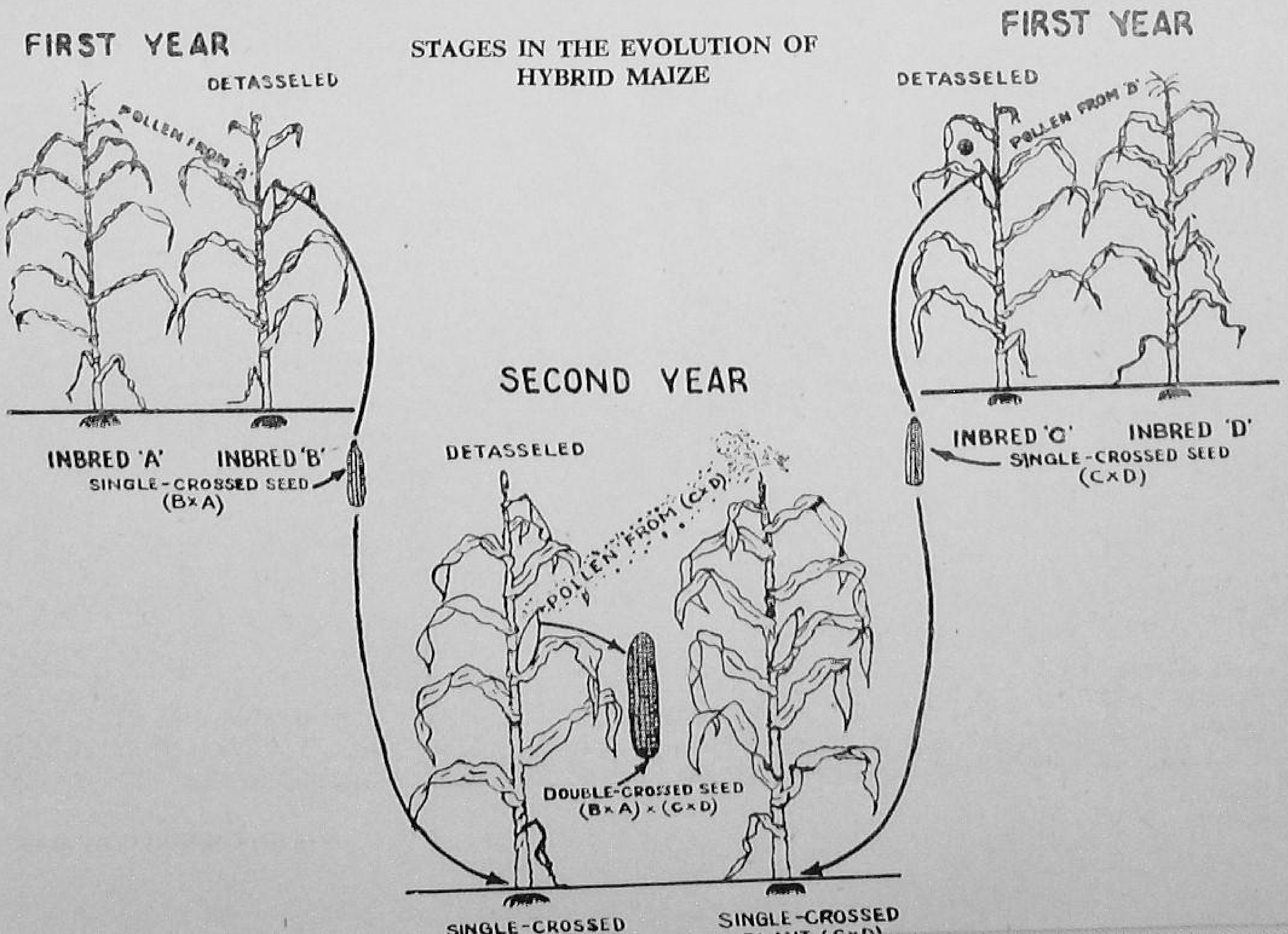
- Seed producers require more than the normal amount of training and skill to be seed producers. The planting of two different strains in alternate blocks across the field requires technical training and supervision. More than ordinary knowledge is required to provide proper culture, plant protection, plant food, irrigation and drainage to enable the crop to produce a high yield of good quality seed.
- To enable a producer to invest in more highly skilled labour and special machinery, to obtain the needed isolation, it is necessary that seed production of this type becomes more concentrated. An area of at least 500 acres is contemplated as an economic unit. Such acreages can be obtained in contiguous land holdings or in similar holdings of cultivators in more than one area.
- This concentration of land, labour, and seed requires that special equipment be available for drying, cleaning, and storing. The usual system of sun-drying a few hundred ears and of winnowing the seed by hand cannot handle the quantities needed nor can the quality of the seed be maintained.
- The concentration of seed thus produced and processed requires sizable godown facilities. These facilities are not only required for short-term storage, but a portion of the seed must be reserved to supply to the cultivators in case a reduced yield should produce a seed shortage. These long-term



The seed is subjected to a germination test in a laboratory

storage facilities will require some means of controlling temperature and humidity for the best preservation conditions for seed.

- The concentration of seed in a few units of production in a state will necessitate that a distribution system be developed to move this seed from the storage godowns to ultimately the farmer's field. Transport facilities must be available for this purpose as well as a well-organized system of moving seed from a concentration of several thousand maunds to rather long distances where it will be utilized.
- The facilities thus provided for production of hybrid maize seed can be used for processing other seeds at other seasons of the year. This will enable the production of seed of higher quality in other crops too. Thus the equipment, training, techniques and facilities that have been concentrated for the purpose of producing high-quality seed of one crop can likewise be used to improve the quality of seed in other crops as well.



STAGES IN THE EVOLUTION OF HYBRID MAIZE

Hybrid maize seed production carries with it the following stipulations or requirements :

Foundation seed stocks can be produced by experienced and highly trained personnel only. The delegation of responsibility in this phase can only result in the production of open pure seed—the very type of seed from which the cultivator seeks to be relieved.

Because of the trained personnel needed, low economic returns and storage requirements for a one year's carryover, this phase of the programme is required to be handled by the Government. Foundation seed production units located in one, two or three states can supply foundation seed stocks to all other states at costs below what could be achieved if every state had a unit. The overhead of staff, equipment, and storage facilities would make one foundation unit in each state an uneconomical operation for all.

Strict inspection of each step ensures purity and quality of seed : (right) *the produce is weighed;* (below) *the seed is finally put in bags, labelled and sealed*

The Seeds Corporation has a programme

By W. H. FREEMAN and G. V. CHALAM

THE registration of the National Seeds Corporation on March 19,1963 is a milestone in the progress of the seed programme in India. The National Seeds Corporation is a public enterprise registered under the Joint Stock Companies Act with a Board of Directors represented by the Government of India, State Directors of Agriculture, representatives of the seed producers, and others directly connected with the seed production.

The National Seeds Corporation has undertaken foundation seed production, certification, and promotional work of the seed programme. At present, the programme of the National Seeds Corporation is directly connected with the production of hybrid maize, and is to be extended to hybrid *jowar* (*sorghum*) and vegetable seeds where the technology of seed production is involved. The National Seeds Corporation will also function for the present as a regulatory and controlling agent in the certification of the seeds in which the Corporation is directly involved, until such time as a National Seed Certification Board comes into existence as a statutory body under the Indian Seed Act.

Though the Corporation was registered only a few days ago, the programme of work envisaged under this Corporation was started by the ICAR Coordinated Maize Breeding Scheme in the production of hybrid maize seed.

In order to stimulate interest among the public, private producers are also encouraged to take up the production of the double cross seed so as to build up a sound private seed industry in the country. A beginning was made in 1960-61 with 7 acres of foundation seed and 4.5 acres under the double cross seed production. The progress up to date is given in the statement below.

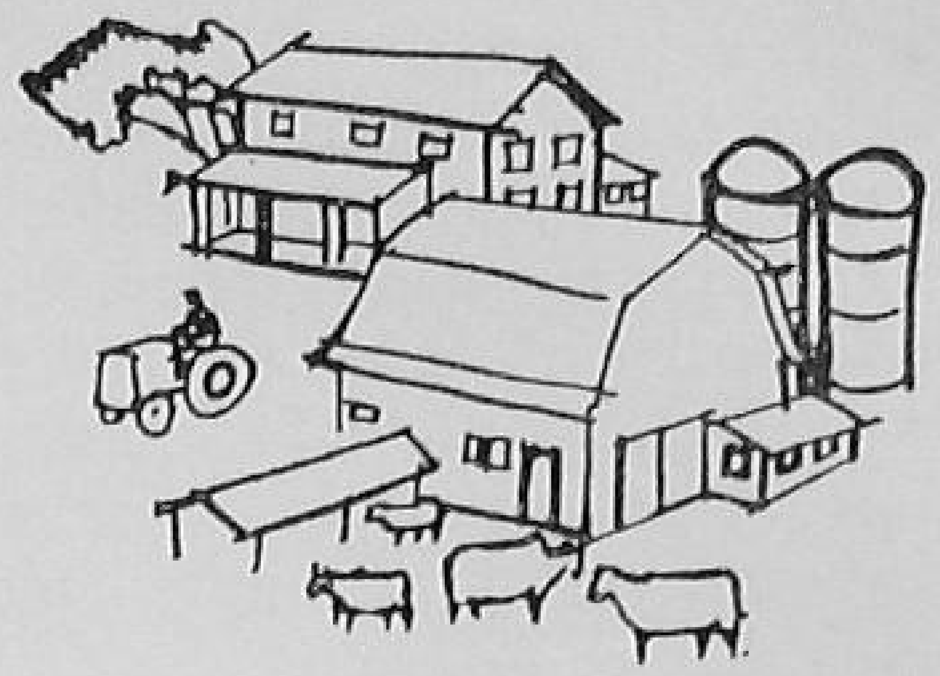
From the above meagre beginning, in 1962 there was an area of 1,134 acres with a production of 15,000 maunds so as to cover an area of 90,000 acres (nearly one per cent of the total maize area) under maize in 1963. By 1966, it is proposed to bring about 19,000 acres under hybrid maize with a production of nearly 300,000 maunds of seed so as to cover 1,800,000 acres (20 per cent of the total maize area) under hybrid maize in 1967. If the present rate of progress continues, by 1970 nearly 55,000 acres will be under the double cross production of hybrid maize seed to cover an area of over 5 million acres (a little over 50 per cent of the total maize area) in 1971. This means that over these 5 million acres there will be an additional increase of production of 20 million maunds of maize available both for food and industry.

Under the National Seeds Corporation it is proposed to establish four foundation seed units during the coming years in the different agro-climatic regions of the country where the necessary foundation seed can be produced. From the overall progress that is likely to be made in the present decade of 1961-70, the rate of progress of the hybhid maize programme is more or less similar to that of the progress in the U.S.

It is gratifying to note that Hybrid *Jowar* Programme also is making headway, and it may be reasonably expected that within the next one or two years the production of the hybrid *sorghum* seed also will be taken up by the National Seeds Corporation which will be another major step in the progress of the seed programme in this country. Besides, various vegetable seeds of improved varieties of proven merits are proposed to be taken up under the National Seeds Corporation as a necessary adjunct to their programme.

Year	Foundation Single Cross Production		Certified Double Cross Production		To be planted to hybrid	Percentage
	Acres	*Pounds*	*Acres*	*Maunds*	*Acres*	
1960-61 *Rabi*	7	6,232	4·5	124	—	—
1961	90	32,226	203	2,600	744	—
1962	180	64,534	1,134	15,000	15,600	0·2
1963	375	120,000	2,540	40,000	90,000	1·0

Hybrids make headway in USA



By RALPH W. CUMMINGS

DURING the past thirty years, the production of maize, the most widely grown cereal crop in the United States of America, has undergone a veritable revolution. With the techniques of inbreeding and the exploitation of hybird vigour mastered, the decade 1930-40 saw the widespread acceptance of the adapted hybrids by farmers in the so-called 'Corn belt' of North Central States.

This was an area having naturally fertile soils and a combination of soil, climate and system of training in which maize had become one of the primary bases of the economy. The newly introduced hybrids had greater uniformity, fewer barren stalks, often greater freedom from disease, better stalk strength and improved vigour over the locally grown varieties. An yield increase of 20 to 30 per cent above that of the previously used local varieties, often claimed for these early hybrids, was significant in an area in which base yields were averaging 20 to 30 maunds per acre and well worth the investment in a somewhat higher seed cost. Not only the farmers favoured buying better hybird seed but also paid more attention to the other factors affecting the yield of the maize plant, and the actual yields began increasing much beyond the quantity expected from the use of hybrid seed alone. Farmers soon found that the hybrids responded better to higher fertility levels and better cultural practices.

At the beginning of World War II, maize hybrids had not been utilized extensively in the more marginal areas in which maize was a secondary crop. In the South-Eastern States, for example, where natural fertility of the soil is somewhat lower, maize had been grown on quite large acreages as a feed crop largely for draft and milk animals and poultry and for human food. Average yields in this area had ranged between 8 and 15 maunds per acre. Some of the hybrids developed primarily for use in the North Central States (the corn belt) had been tried here but had not proved satisfactory. Some reasonably good yields were obtained, but generally the maize tended to be soft and starchy, and very easily attacked by grain weevils and other insects. The husk covering was also short and loose, not only exposing the grains to insect and bird destruction but also to moisture from the late summer and autumn rains, resulting in a great deal of grain and cob decay.

Early attempts to develop adapted hybrids for these areas did not excite a great deal of interest. As long as yields were in the range of 8 to 15 maunds per acre, an increase of 20 to 30 per cent might be interesting and useful, but not great enough to create a great deal of enthusiasm. But, by this time, with enough experience and information accumulated, scientists felt convinced that there was no need for yields to remain at such low levels. The advent of World War II and the urgency of fully utilizing all available farm resources to provide the food, fibre and other raw materials required by our own nation and our allies, gave an added stimulus and urgency to put science to work in getting the maximum return from all the crops and from the acreage under crops. The decade 1941-1950 thus saw maize hybrids developed specifically suited to the South-Eastern States, and come into widespread use.

A series of experiments conducted by Dr. B. A. Krantz and Dr. P. H. Harvey of the North Carolina Experiment Station, during the period 1943-1946, were very significant in this respect. Utilizing the hybrids developed by Dr. Harvey for adaptation to the area, Dr. Krantz concentrated his attention on the

study of soil fertility and fertilization, soil management, plant populations, weed control and other cultural practices. His experiments were carried out in farmers' fields over a wide range of soil types and covered a wider range in weather patterns. These provided valuable information on the requirements of the maize plant and various factors affecting its productivity. For example, in a set of experiments the nitrogen supply in the soil proved to be one of the most nearly universal factors limiting maximum yields.

Under another set of conditions, it was seen that nitrogen was the limiting factor no doubt at low yield levels, but that a point was reached at which some other factor became limiting. This could be a factor like insufficient moisture, insufficiency of some other essential element, inadequate drainage and soil aeration, plant population, weed competition or disease susceptibility of the hybrid.

A careful analysis of these experiments enabled scientists to lay down the levels of fertilization and the various cultural practices, which could give the most profitable returns to the farmers. Intensive extension programmes were undertaken on this basis.

The average yield levels of maize in all parts of the USA have risen steadily over the past 20 years as a result of the use of maize hybrids and of continued improvement in the use of fertilizers and cultural practices. In North Carolina, the average yield of all farmers in the State rose from 15.5 maunds per acre (maximum average prior to 1943) to 40 maunds in 1962. In Illinois, the State average has now exceeded 56 maunds per acre. Similar increases have been registered throughout the USA as a result of development and application of improved production practices.

HYBRID MAIZE IN INDIA

The present yields of maize in India are roughly comparable to those which were obtained in the South-Eastern part of the USA, a generation ago. The new maize hybrids—*Ganga 1, Ganga 101, Ranjit, Deccan* and *V.L. 54*—have proved their adaptability, superiority and usefulness in the various parts of India. More of such superior hybirds are expected.

The soil and climatic conditions under which maize is grown in India differ materially from those in the principal maize-growing areas of the USA, and will require continued research to discover the best combination of practices for attaining high yields dependably and consistently. However, enough is already known to demonstrate quite conclusively that maize can and should have a much more important place in helping to meet India's food requirements. We are undoubtedly on the threshold of very significant development, and can look forward confidently to an era in which maize will contribute much more food to India, not only in lands presently devoted to it, but also as a result of its extension into new areas, as more experience shows the way to dependable high yields.

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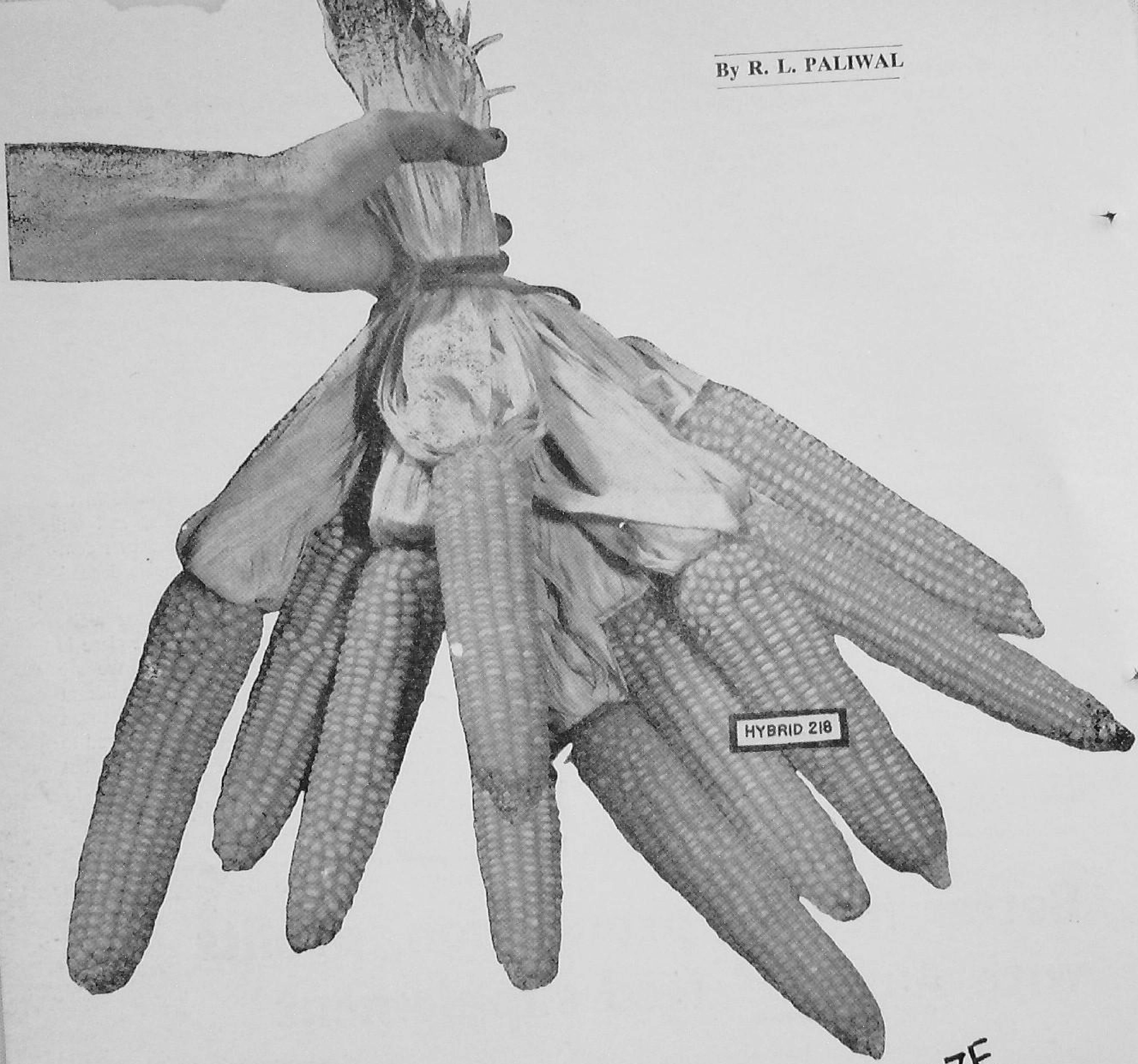
By R. L. PALIWAL



NEW STRAINS IN HYBRID MAIZE

THE production of hybrid maize varieties has been one of the most notable developments of the 20th century. Today breeders in almost all countries where maize is of importance, are busy developing new hybrids.

Maize is one of the most ancient and important food plants. Even with the appearance of other cereals on the agricultural scene, its importance has not been in the least minimized. Instead, it has taken a different and additional turn towards industrial use. A

very important feature of maize is that potentially it is capable of giving much higher yield than any other cereal at present under cultivation.

In India, the first attempts in the improvement of maize were made at the Vivekananda Laboratory, Almora (Uttar Pradesh). In 1947-48, maize breeding work was started at the Indian Agricultural Research Institute and in 1957 the Coordinated Maize Breeding Scheme was set up on an all-India basis. The Scheme started functioning with active collaboration between the Indian Agricultural Research Institute, the Rockefeller Foundation and different State Departments of Agriculture. The coordination office was set up at the I.A.R.I. As a result of this cumulative work, very outstanding results have been obtained in the development of hybrid maize.

Double cross hybrids have been mostly used for the commercial exploitation of hybrid vigour in field maize. In 1961, four double cross hybrids developed by the Coordinated Maize Breeding Scheme were released. These were *Ganga Hybrid Makka 1* and *Ganga Hybrid Makka 101* for the northern plains, *Ranjit Hybrid Makka* for southern parts of Rajasthan, Gujarat and Maharashtra, and *Deccan Hybrid Makka* for peninsular India.

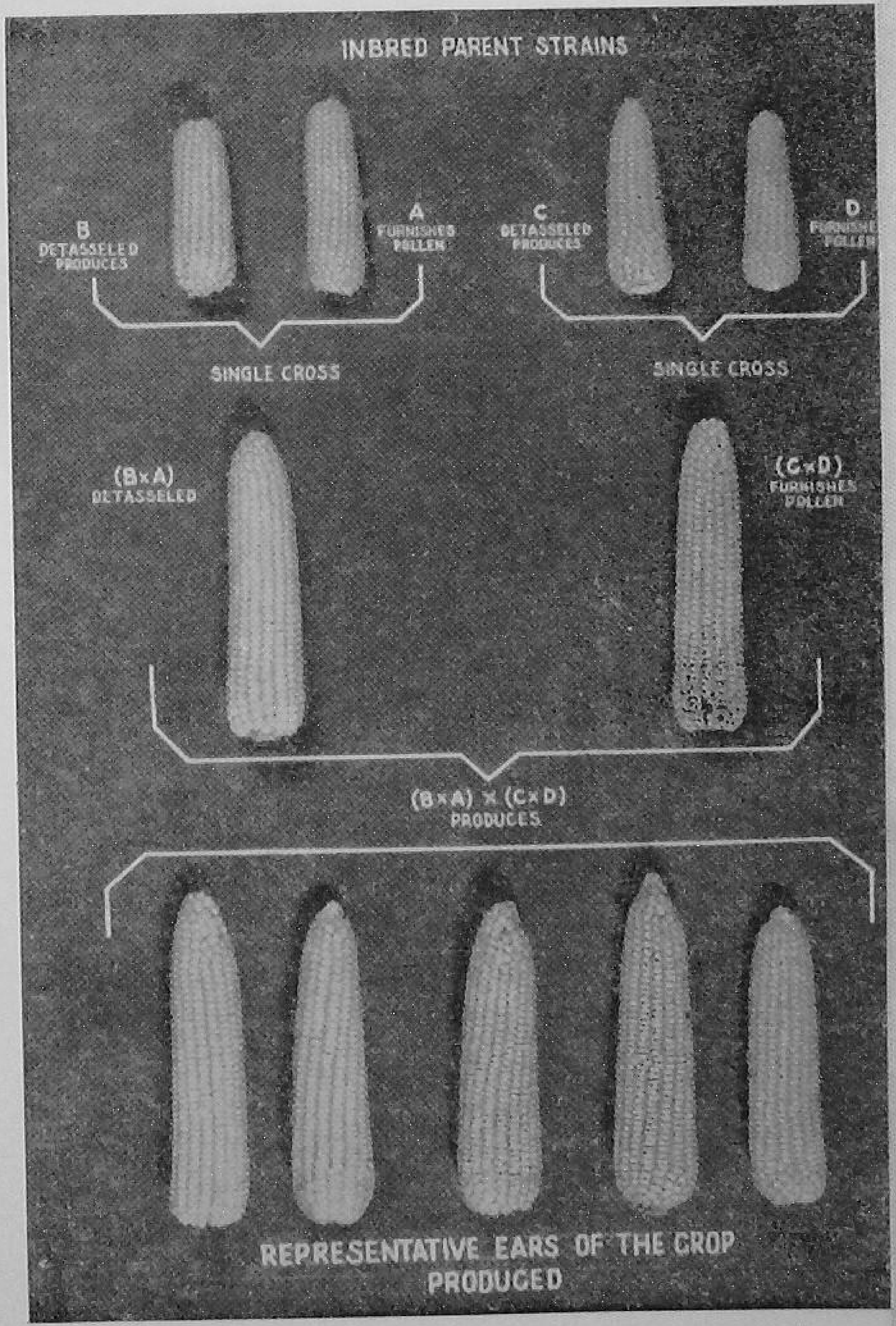
These hybrids have excellent reproduceability, vigour and pollen formation, good standability and husk cover. They are also fairly resistant to diseases and tolerant to pests. *Ganga Hybrid Makka 101* has very attractive orange flint grain and is becoming very popular with the farmers of the northern plains, while *Deccan Hybrid Makka* is doing extremely well in peninsular India. These hybrids have another advantage in that they are more leafy and remain somewhat green at the time of grain harvest and thus produce more fodder and of a better quality.

The yield performance of the four released hybrids in tests carried out at 33 different locations throughout India show that *Ganga Hybrid Makka 1* is earlier in maturity than the other three hybrids, but is a comparatively lower yielder. Our attempts have been directed towards the evolution of a double cross hybrid which will mature earlier and still give a good yield. One such experimental *Hybrid No. 218* has given excellent performance for two successive years throughout India. It is at least a week earlier in flowering than *Ganga 101, Deccan* and *Ranjit Hybrid Makka,* and is almost as early as most of the local varieties. It has very shining yellow flint grains and good agronomic characters. How its yield compares with other hybrids can be seen below :

Name of Hybrid	*Yield in kilograms per hectare* 1961	1962	Days to Silk
Experimental Hyb. No 218	5542	5778	57
Ganga 1	4081	4067	55
Ganga 101	5071	5643	63
Ranjit	—	5300	64
Deccan	—	5943	63
Local	3690	3766	56

The hybrid out-yielded *Ganga Hybrid Makka 1* and its yields are either equal to or a little higher than

The process by which a new hybrid is evolved



The production of hybrid seed is a job which requires handling by skilled personnel at all stages

Ganga 101, Ranjit and *Deccan Hybrid Makka.* This hybrid is being recommended to the Release Committee to replace *Ganga Hybrid Makka 1.*

Recently a hybrid *VL 54*, developed at the Vivekananda Laboratory, Almora, has been released by the Hybrid Release Committee for the hilly areas.

We now have good and successful hybrids with orange/yellow flint grain type and desired maturity for the hills, the plains and peninsular India; white grained hybrids for areas where the preference is for white grains; hybrids which may be more suitable for the starch industry; hybrids which yield good green fodder as well as better stover and are becoming popular with the dairy farms. We also have a sugary hybrid where the genes for sugary character have been transferred to a field maize variety to meet the requirement of the kitchen gardeners and those areas in and around the cities where farmers sell green ears for roasting.

It is not enough if farmers use hybrids for sowing. They must know that maize hybrids perform better under high fertility conditions and with proper agronomic practices. The per-acre production of foodgrains can be considerably increased by growing a hybrid maize-wheat rotation accompanied by the recommended cultural practices. This way, with suitable maize hybrids and wheat varieties, it is possible to obtain grain yields of about 70 to 80 maunds of maize and 30 to 40 maunds of wheat per year on the same acre of land. This means 100 to 120 maunds of foodgrains per acre per year. The rotation would be very profitable to farmers in the northern plains of India where maize and wheat make the two major cereals.

At the Indian Agricultural Research Institute, on a 15-acre field, hybrid maize-wheat rotation was followed in the last three years. In this field, various maize hybrids with variable (high, medium and poor) yield potential were tested along with local varieties. The average yield of maize per acre obtained each year is remarkable. A part of this increase in yield may be due to the better hybrids grown, but a good part of the increase is also due to building of fertility in this field during these years of cultivation of hybrid maize with recommended doses of chemical fertilizers (100 pounds N, 60 pounds P_2O_5 and 40 pounds K_2O) and good cultural practices. The cost of fertilizers applied and the pains taken are more than compensated by increased yields and increased soil fertility.

Did you know—The only hybrid seed available is produced anew each year by detasseling one of two single crosses?

By V. M. SAHNI

RAISING A GOOD HYBRID MAIZE CROP

Growing a hybrid, no doubt, demands more labour and care in following the recommended practices. But the pains taken are rewarded by a sizable yield

GROWING hybrid maize is not merely a matter of sowing a new kind of seed. To get high yields from hybrid maize, you have to follow improved production methods.

Maize hybrids are high yielding and respond much more profitably than local maize to good cultural practices. These include crop rotation, land preparation, time and method of sowing, seed-rate and plant population, intercultivation, irrigation and drainage, plant protection, and most important of all, optimum manuring. You must understand these carefully when growing a hybrid maize crop.

CROP ROTATION

A proper crop rotation is extremely important for a good maize crop. Being an exhaustive crop, maize breaks down a good soil structure, and must be followed by a crop which builds up soil structure.

The most common rotation practised in India is: maize followed by some small grain like wheat or barley. In many areas maize is followed by gram, lentil or mustard, whereas in hilly tracts a crop of potatoes is taken after maize.

The best thing would be to follow maize by some green manure crop like sannhemp (*Crotolaria juncea*), *guar* (*Cymopsis* sp.), *dhaincha* (*Sesbania* sp.) or berseem. Plough the green manure crop into the soil.

LAND PREPARATION

Preparing a fine seed-bed for maize is essential. Shallow ploughing for centuries has resulted in the formation in many soils of a compact layer about six to eight inches below the surface. Give two ploughings with a furrow-turning plough six to eight inches deep. Follow each ploughing with planking to break the hard pan.

After this, give two ploughings with a light *desi* plough. After each ploughing, give a planking by a wooden plank, so as to make the soil compact and even. Light ploughing will help in making the top-soil fine, but not powdery and firm. In such a soil the seed comes into close contact with soil on all sides and moisture moves readily through it.

If your farm is mechanized, give one deep ploughing with a mould-board plough and two discings (first heavy and then light). Follow each discing with running a spike tooth harrow. This will make a fine seed-bed.

Don't make the soil surface powdery, as otherwise a hard crust will form after the rains, which prevents the seedlings from coming out.

SOWING

Maize is generally grown in India as a *kharif* crop. In some parts of Bihar, Gujarat, Andhra Pradesh, Mysore and Madras, it is also grown in *rabi*. In *rabi*, it is sown with irrigation in October-November.

The *kharif* sowing starts with the onset of monsoon in June-July, or by the end of April in hilly areas like Kashmir. In some part of Mysore, sowing is done in April and May. In the canal tracts of the Punjab, maize is sown as late as in August.

Desi maize is generally sown by farmers by broadcasting. However, in the case of hybrid maize, line-sowing is important.

Drill or dibble the seeds six inches apart at a uniform depth of two inches, in lines 30 inches apart. Stepping on the line will help bring the soil into close contact with the seed and also prevent moisture evaporation, and will ensure good germination.

Line-sowing helps in the economical use of the costly seed, and makes intercultural operations easier.

Use the hill method of sowing, if possible. This will be the best. Cross-mark the field 30 inches apart, and dibble three seeds at each hill or cross-mark, followed by stepping on the hill. The hill method makes cross cultivation possible.

SEED-RATE AND PLANT POPULATION

A proper seed-rate is very important for getting good yields. Too thin sowing will result in too little of plant population. Too thick sowing, on the other hand, will result in too much competition for food among the plants. In either case, it will result in lower yields.

The optimum plant population for hybrid maize is 18,000 to 20,000 plants per acre.

To achieve this, use a distance of 30 inches from row to row and 12 inches from plant to plant. Sow the seeds 6 inches apart, and later thin out seedlings to 12 inches apart. You will need six kilograms to hybrid maize seed to sow an acre.

INTERCULTIVATION

The main purpose of intercultivation is to control weeds. Intercultivation also helps in the aeration of soil and its capacity to absorb water. However, deep intercultivation does more harm than good. The primary objective, therefore, should be to kill weeds just before or soon after their emergence.

Give the first weeding with a hand hoe when the plants are about six inches tall. Do not carry out any weeding operations, if the fields are too wet. Under wet conditions, pre-emergence sprays after germination but before the leaf stage, will help control the weeds.

Give the second weeding when the plants are 16 to 18 inches high. From this time onwards, weeding too deep or too close to the plants will be injurious to the crop, as by this time the roots will have spread outwards.

After one or two hand weedings, use a *desi* plough or bullock-drawn hoe or mechanical cultivator for a better and quicker job. Follow the last hoeing with earthing up for better anchorage.

IRRIGATION AND DRAINAGE

In India, maize is primarily grown as a *kharif* crop, and is sown with the onset of the monsoon. With highly erratic distribution and fall of rains, efficient water management is of utmost importance.

About 25 inches of water, well distributed over the growing season, is required to produce a good crop of maize. This may be supplied by rainfall or irrigation or both. If rains fail, it is necessary to irrigate the crop at 15 days' interval or before the plants show sign of wilting.

In case of excessive rainfall, drainage is even more important. The maize crop is said to suffer more from excessive water than from water scarcity. Therefore, do not let water stand in the field.

For surface drainage, level the fields before seeding. Put parallel ditches across the field at a regular distance of 100 feet. Do the planting and intercultivation at rightangles to the drainage ditches. The irrigation channels thus formed due to intercultivation will

open into the drainage ditches which in turn will carry away the excess water.

PLANT PROTECTION

Maize like any other crop is subject to attack by a number of pests and diseases which reduce the yield very much. With proper and timely adoption of plant protection measures, much of this loss can be reduced. A combination spray (compatible insecticide and fungicide) of BHC 5 per cent wettable powder (25 gm/gallon), 'Endrin E.C.' (10 c.c./gallon), wettable sulphur and copper oxide, will help control the pests and diseases.

Use extreme caution in handling the insecticides.

OPTIMUM MANURING

Though maize hybrids have a great high-yielding ability, yet a good harvest cannot be expected without the use of fertilizers in adequate quantities. Without heavy manuring, hybrid maize may even give less yield than the local maize.

Apply 15 to 20 cartloads of farmyard manure before ploughing, and thoroughly work it into the soil. The requirement of inorganic fertilizers will vary from soil to soil. But generally 100 pounds of nitrogen, 60 pounds of phosphate and 30 pounds of potash should be applied per acre.

To avoid nitrogen losses by leaching, split the applications as shown below :

At the time of planting apply 30 pounds of nitrogen, 60 pounds of phosphate and 30 pounds of potash, about three inches below and three inches to the side of the seed.

When the plants are one to two feet tall, give the second application of 40 pounds of nitrogen about 10 inches to the side of the plants, and work it lightly into the soil. Give the last dose of 30 pounds of nitrogen when the plants are about three feet tall. However, some people prefer to give the remaining 70 pounds of nitrogen at the time of the second application.

Follow all steps carefully to get high yields from hybrid maize.

Always buy Certified Hybrid Maize Seed.

Blue tag on your seed bag is a guarantee of genuine and high-quality seed.

Follow recommended cultural and manurial practices to exploit fully the yield potential of Hybrid Seed.

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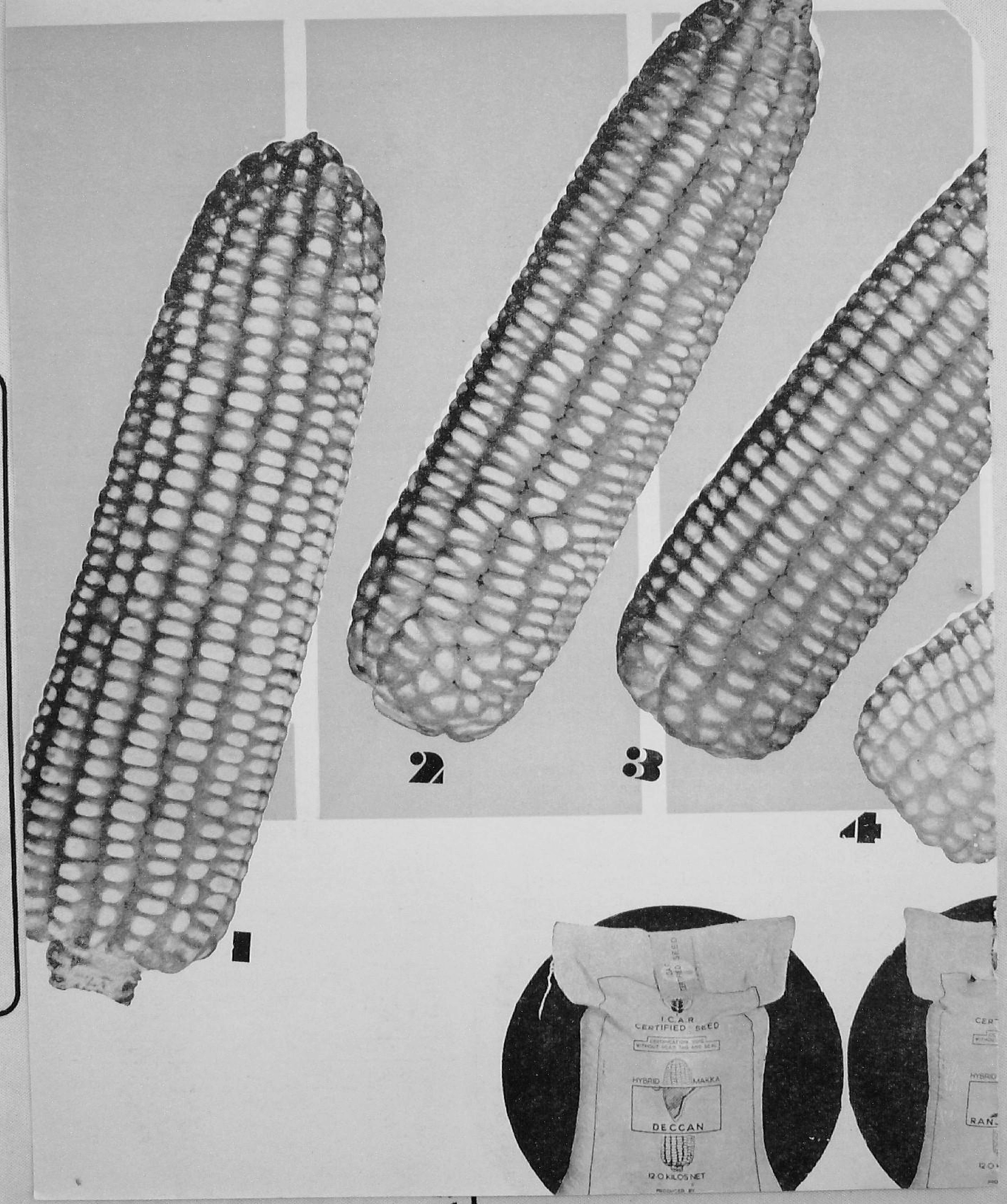
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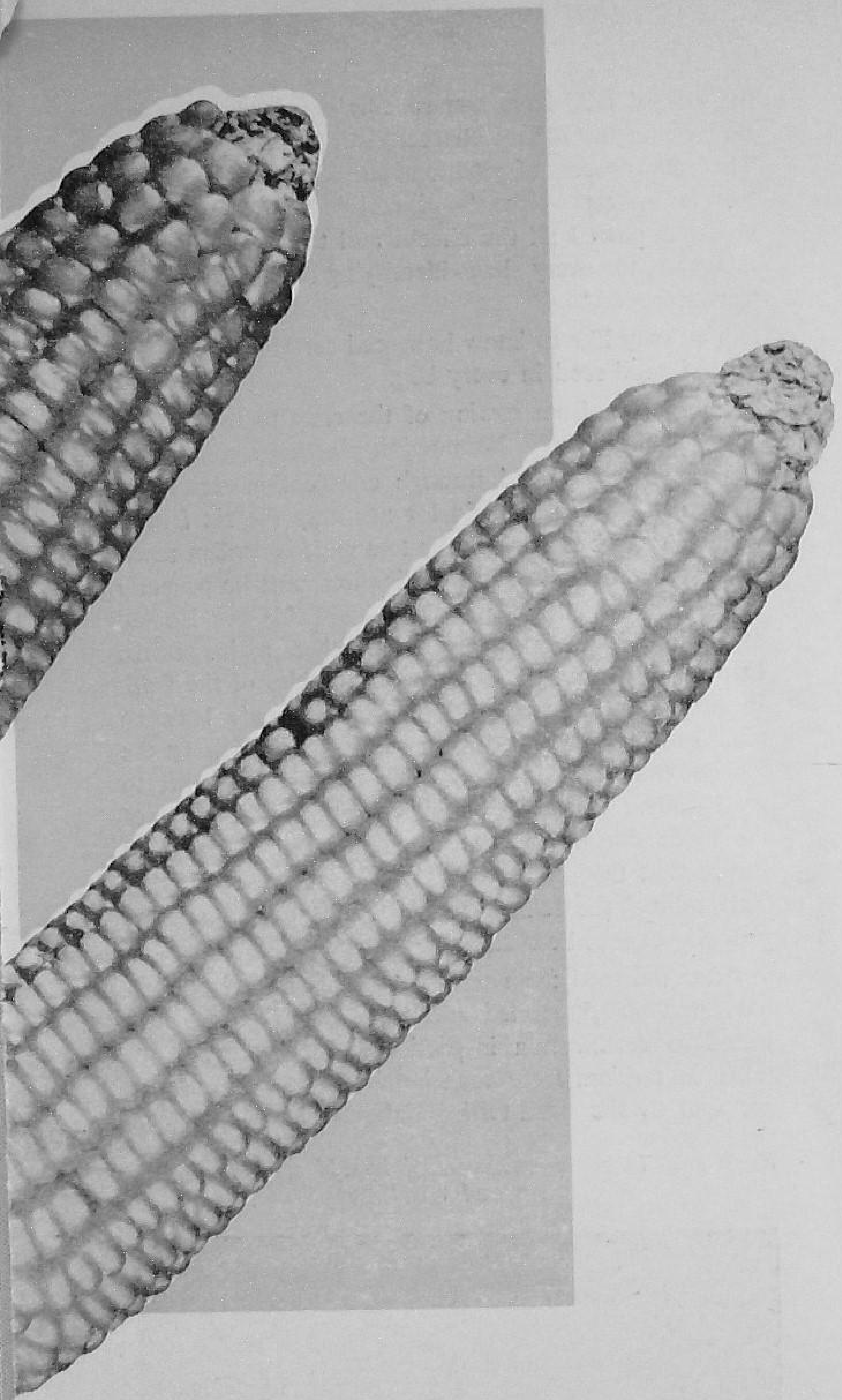

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   Vigorous-growing; high-yielding, with good grain quality and taste; late-maturing; resistant to leaf-blight and other pests; fast becoming popular with farmers.

2. *Ranjit* : Suited to Southern Rajasthan, Gujarat and Maharashtra.

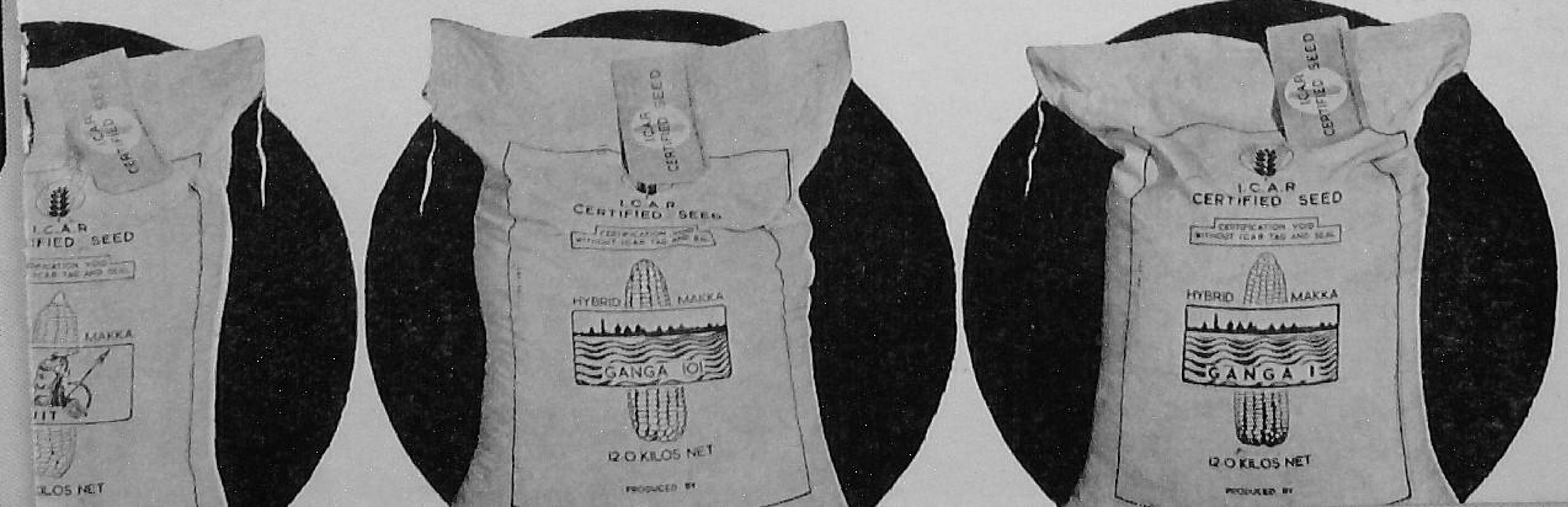
   Yields 40 to 100 per cent more than local; resistant to diseases and does not lodge; tall-growing with abundance of leaves; tight husk covering which reduces bird damage.

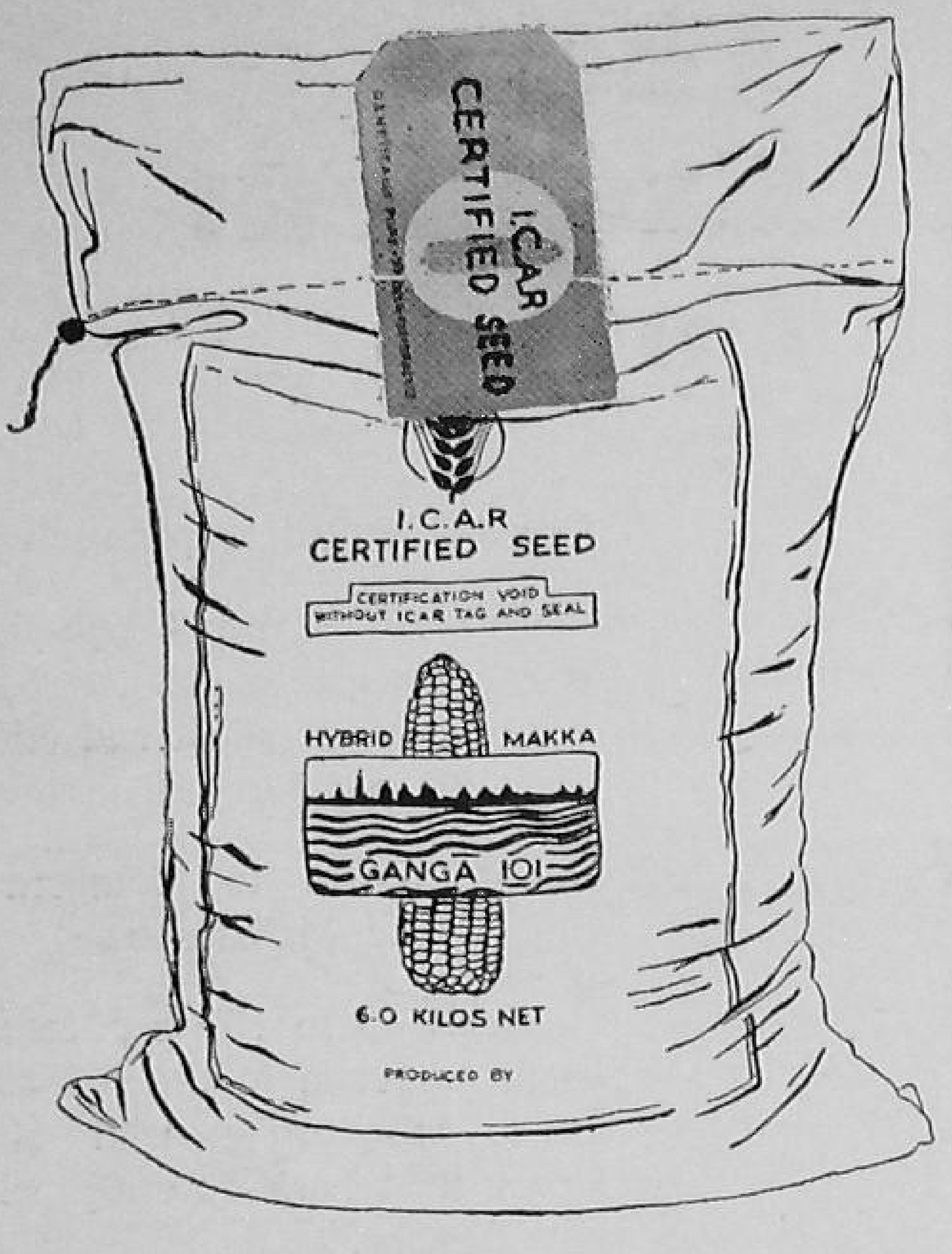
3. *Ganga 101* : Recommended for northern plains.

   Yields high under a wide range of environmental conditions; late-maturing; great leaf-disease resistance; excellent husk protection to cobs; grain good for *chapati*-making.

4. *Ganga 1*: Suited to north India in general.

   Early-maturing (80 to 90 days); yield 20 to 75 per cent more than local; tolerant to several diseases and pests; can be sown with irrigation in March-April for green cobs and fodder.





CERTIFIED SEED—the start of a big yield

By JOHNSON E. DOUGHLAS

CERTIFIED seed of hybrid maize assures a farmer of a good start for a bumper yield. Using your own hybrid maize seed or that from a neighbour's field will result in a very poor yield, and disappointment. The hybrid maize seed which you want to buy should, therefore, be 'good seed.' No doubt should exist regarding whether the seed is truly of the hybrid type or if the seed will germinate vigorously. The seed must be 'first rate.'

In order that our maize farmers get really high yielding maize seeds, the production programme of all hybrid maize seed is being checked thoroughly. These inspections determine if the seed-production field and the graded seed have met specific standards regarding trueness to the hybrid characteristics and seed quality. This total process of genetic assurance and quality control is known as the 'seed certification.' After the seed has passed all the checks and tests, a blue tag is attached to every bag identifying the contents as 'certified seed.'

You may like to know how seed certification assures you of good seed in every bag.

Every step from sowing of the crop to the harvest is watched carefully. Foundation planting stock, which has previously passed through certification standards, is used in every seed-field for not only the six female or seed rows but also for the two male or pollen rows. To produce hybrid maize, pollination must be properly controlled. That is why all seed-fields are located at least 200 meters away from other maize fields. Inspectors check this distance on all sides of the field. In order that a proper cross may be made between male and female rows, 99 per cent of the tassels on the female rows are removed daily before they start to shed pollen. Inspectors make surprise inspections of the fields during the tasselling and silking period to assure that the seed-grower is doing a proper job of 'detasselling' the female rows. Fields not detasselled properly cannot be certified.

After the seed from only the female rows has been harvested, dried, graded and treated, it is again subjected to certification inspections. Seed samples are taken at random from each batch or lot of seed, and are sent to the seed-testing laboratories with good

Each step in the production of hybrid seed has to be watched carefully

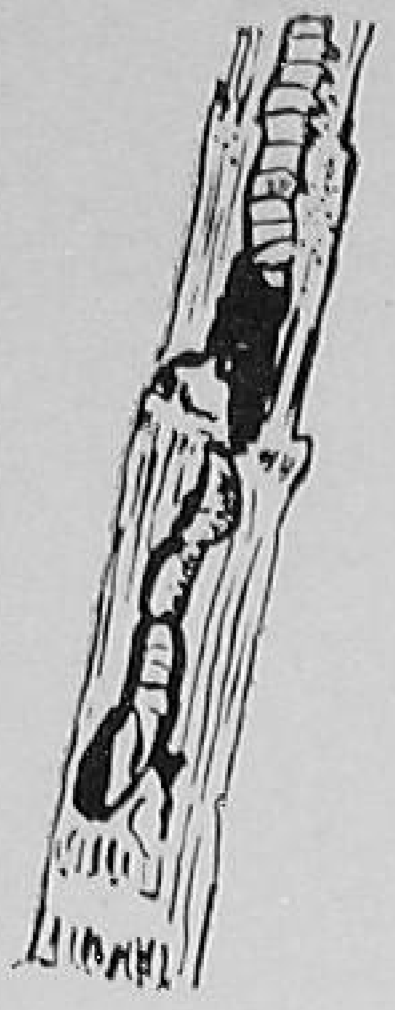
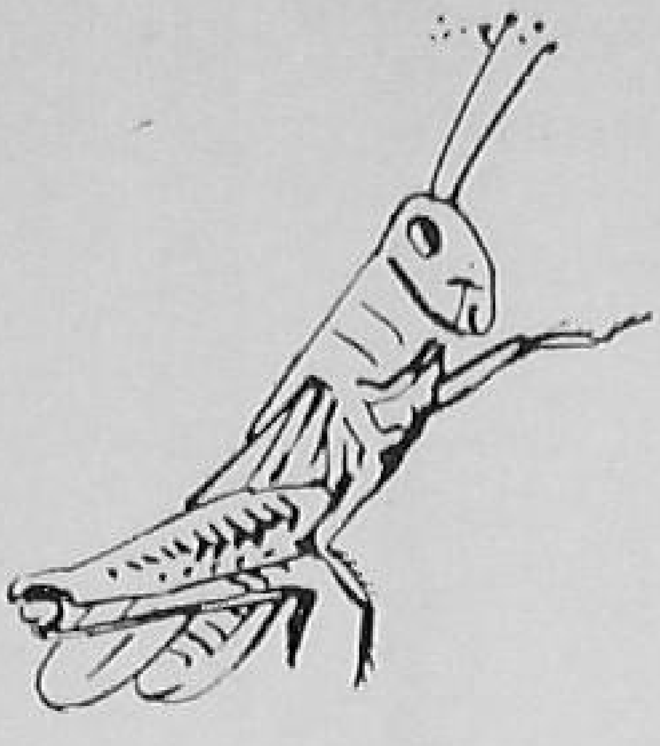
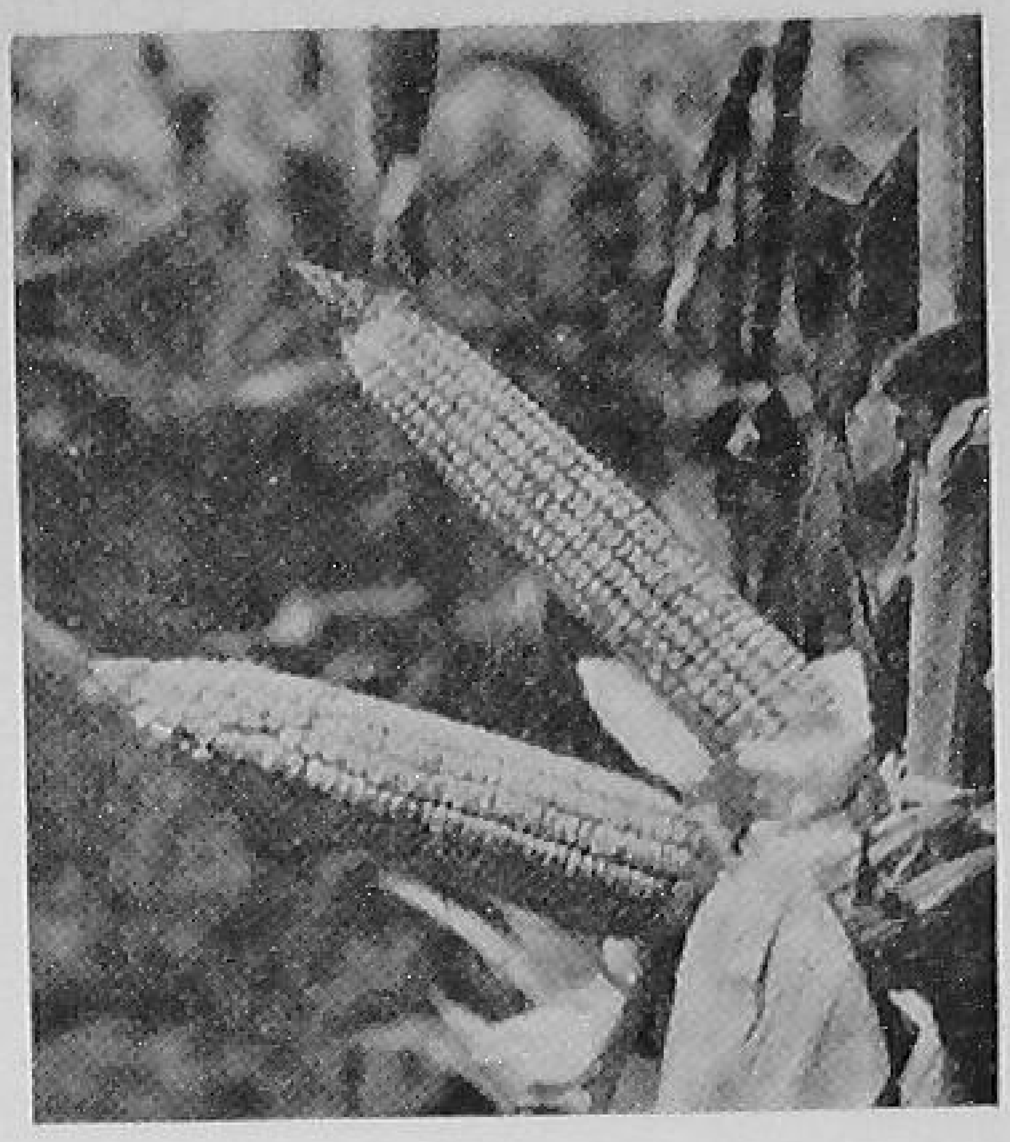
The blue ICAR tag used on the seed bags of hybrid maize is a guarantee of purity and quality of the seed inside

representative samples for inspecting. In the seed laboratory, tests of the seed-moisture content are made, because stored seed containing over 12 to 13 per cent moisture will not maintain good germination. The trained seed analysts also check the seed to assure that only the female seed has been saved and that grading has been carried out carefully.

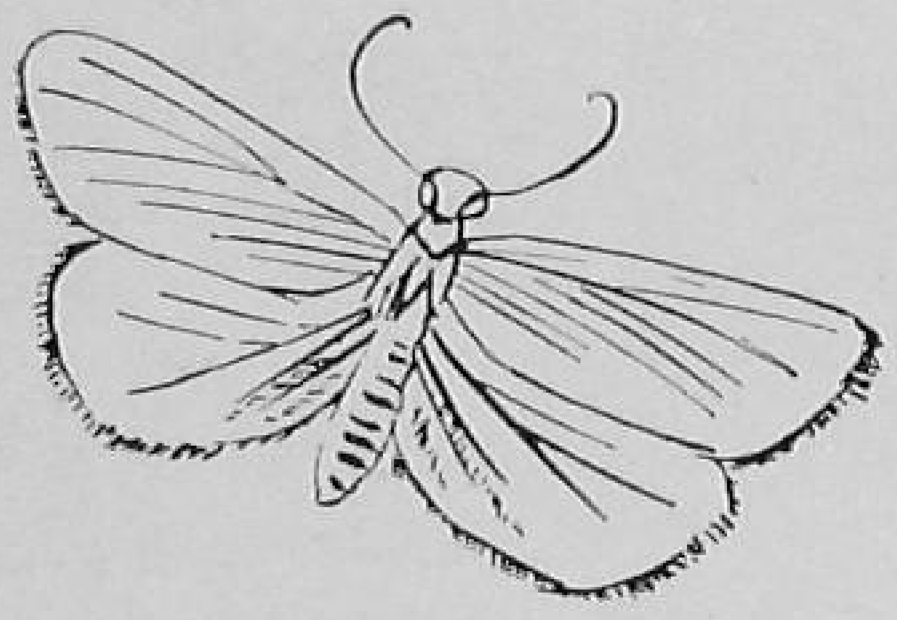
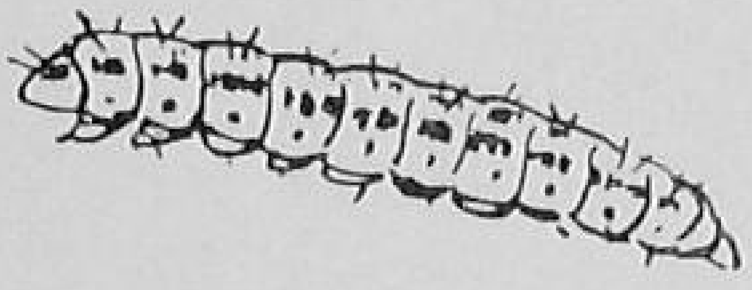
Seed germination cannot be determined by merely looking at the seed; therefore, every lot has again to be tested. Specially-prepared sand boxes or rolled paper towels are used to hold the seeds for testing. Two to four replications of 100 seeds each are placed in temperature- and humidity-controlled germination chambers for seven days and tested for a high germination standard.

After all these tests, the seed is bagged, sealed and tagged as 'certified hybrid maize seed' for sale to the farmers. Since this seed is a hybrid, produced by crossing distinct, known lines, you will need to purchase new seed every year.

So whenever you buy seed, look for the blue tag which says 'certified.' If it is in a sealed, nice-looking bag, you know the seed inside must be good.

Taking care of pests and weeds

By D. B. REDDY

FROM the time of sowing up to harvesting, the maize crop is attacked by many insect pests. You have to take timely measures to check these pests which might otherwise reduce the yield and quality very badly.

You have also to check weeds which compete with the maize crop for nutrition, water, light and space. They also carry pests and diseases which attack the maize crop.

Among the many insects which attack the maize crop, the important ones are : termite, grasshoppers, beetles, borers, army-worms, aphids and hairy caterpillars. Of these, borers and the hairy caterpillars do the greatest damage.

TERMITES

Termites or white-ants cause heavy damage to the young crop, especially in non-irrigated areas when there are no rains. The attack may start soon after the germination of the crop, and may continue in later stages. Sometimes the maize straw may also be destroyed by termites.

If termite trouble is regular, carry out soil treatment by incorporating 20 pounds of 10 per cent BHC dust or 5 per cent 'Aldrin' dust, per acre. These chemicals will also control wireworms and cutworms. If the attack comes after sowing, irrigate the crop, where possible. This will reduce the severity of the attack.

GRASSHOPPERS

Grasshoppers attack the maize crop mostly in the younger stage. Both the adults and the young ones of these insects damage the crop. The damage is very serious, when they are in large numbers. The *phadka* grasshopper, rice grasshopper and the Deccan wingless grasshopper cause the greatest harm to the crop. You can control grasshoppers easily by dusting the crop with 10 per cent BHC at 15 to 20 pounds per acre.

HAIRY CATERPILLARS

Another group of insects which destroy the crop in the young stage are the hairy caterpillars. One of these is the *katra* which is mostly found in north India. The other is the red-hairy caterpillar which attacks the maize crop in south India. These caterpillars attack the young crop and completely eat it away.

The hairy caterpillars usually make their attack in large numbers and over large areas. With the first

monsoon showers, the moths emerge out of the pupae which are in rubbish, bushes or in the soil. After a few days, the moths lay eggs on almost every green plant. When the caterpillars hatch out, they start feeding voraciously, and march from one field to another, eating almost everything green on their way. They also attack a large number of other crops especially pulses and groundnut. In some cases, resowing of crops becomes necessary.

The control of the hairy caterpillars is difficult, unless it is done in time, systematically and on a co-operative basis.

The moths are attracted to light. Employ light traps to catch the moths during the period when they emerge out of pupae. Keep the traps for a number of days after the first showers of monsoon, and continue till the moth catch in the traps is very little. Light trapping will be effective only when it is done on an area-wise basis.

You can also kill the caterpillars in their young stage, by dusting 10 per cent BHC or 2 per cent 'Parathion.' Spraying 'Parathion' 0.05 per cent will also be good.

However, you can control the caterpillars only in the young stage. Later on it will be very difficult to control them. Also, the success of the control operations will depend on the combined effort of all the farmers of your area.

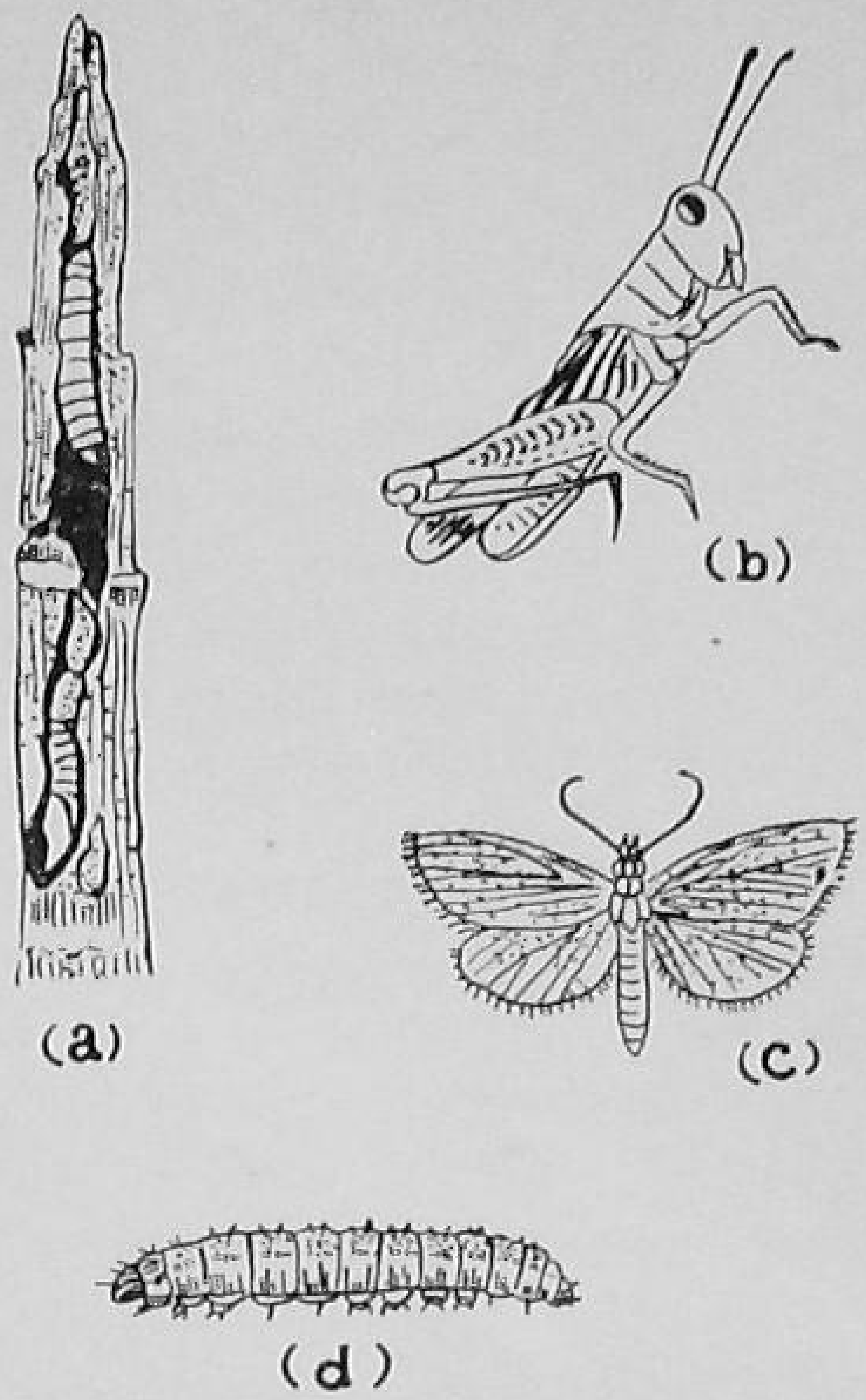
BORERS

The most important insect of maize is the maize borer *Chilo zonellus*. This insect attacks the crop at all stages of its growth. The attack can start within 10 to 15 days after germination and can continue till the cobs mature. The caterpillars of this insect have a black head and a dirty white body. In the young stage, the caterpillars bore into the growing shoot through the whorl and kill the plants, causing the typical 'dead-hearts.' In later stages, the larvae make a tunnel through the stem, and may kill the growing parts. They even bore through the cobs and eat the grains.

The moths of this borer are brown in colour. The front wings are straw-coloured, with a double row of black spots along the outer margins. They are active at night.

This insect is active from June to November and causes damage to many crops including *jowar* and *bajra*. It also causes a heavy damage to the maize crop grown during winter.

There is another borer known as the pink borer. Its habits and the nature of damage are similar to



(a) The caterpillar and pupa of borer inside a stem; (b) grasshopper; (c) a female moth of the borer; (d) a borer larva

those of the maize borer, but its attack is not so severe.

You can control the borer by spraying 0.25 per cent DDT or 0.03 per cent 'Endrin.' Where borer attack is regular, give the first spray two to three weeks after germination of the crop, just when the larvae hatch out and before they enter the stem. One or two more applications may be necessary to obtain an effective control.

Plough up the field after the season and destroy the stubbles. Only vigorous control operations will keep the pest under check.

OTHER INSECTS

Aphids sometimes become serious on the young crop. They suck the juice of plants and make them sick, thus affecting their growth. You can control these insects easily by dusting 10 per cent BHC or by spraying 0.2 per cent BHC or 0.02 per cent 'Endrin.'

In some areas, armyworms become a serious problem. They eat the leaves and later may attack the silks and ears. They may even feed on the developing kernels and damage the cob. Dust 10 per cent BHC at the early stage of the crop. Spray 0.25 per cent DDT or 0.25 per cent 'Endrin' at the later stages of crop growth.

Other insects like beetles and bugs may sometimes attack the crop. However, they are of minor importance. You can control the beetles, especially the flea beetles by dusting 5 per cent BHC or DDT. For controlling the bugs, dust 5 per cent BHC, or spray 0.2 per cent BHC or DDT.

In certain areas, the lucerne caterpillar also attacks the leaves of the maize crop during July and August. To check this pest, use the same control measures as are used against the hairy caterpillars and armyworms. The notorious gram pod-borer also attacks the cobs of maize, but this pest is of minor importance.

BIRDS AND ANIMALS

When the grains are maturing, the crop is attacked by birds like parrots and crows, and also by jackals and monkeys. The damage is considerable, especially when the plots are small and isolated. There is no chemical control against these pests, but you should scare them away, as far as possible.

You can use the Mechanical Bird Scaring Machine for this purpose. It produces loud sounds at definite intervals. This machine has been found very effective against birds and jackals and even against monkeys. The cost of operation of this machine for a period of 24 hours is about Rs. 1.50 to Rs. 2. Some cultivators who have used this machine have found it very effective in keeping out the birds and the jackals.

WEEDS

A large number of weeds compete with the maize crop for nutrition, and reduce the yield considerably. Most of the dicot weeds occurring in the maize crop can be controlled by the use of chemicals.

Apply sodium salt of 2, 4-D at the rate of 1½ pounds acid equivalent per acre, after the crop has been sown but before it has emerged above-ground.

But apply the herbicide only when the variety of maize you have sown is known to be tolerant to this chemical.

When the crop is about 10 to 12 inches high, give a shallow hoeing followed by earthing up a week after. After earthing up, spray sodium salt of 2, 4-D at the rate of one pound acid equivalent per acre to destroy the fresh growth of weeds.

Most of the insecticides and herbicides are poisonous to animal and man. Hence, take all precautions while handling them.

Make a systematic schedule of operations against pests and weeds and carry out the operations in time. The success of these operations will determine greatly the yield you will obtain from your maize crop.

HYBRID MAIZE

☆

RANJIT AND DECCAN

★

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- **Increase Agricultural Production by Growing Hybrid Maize.**

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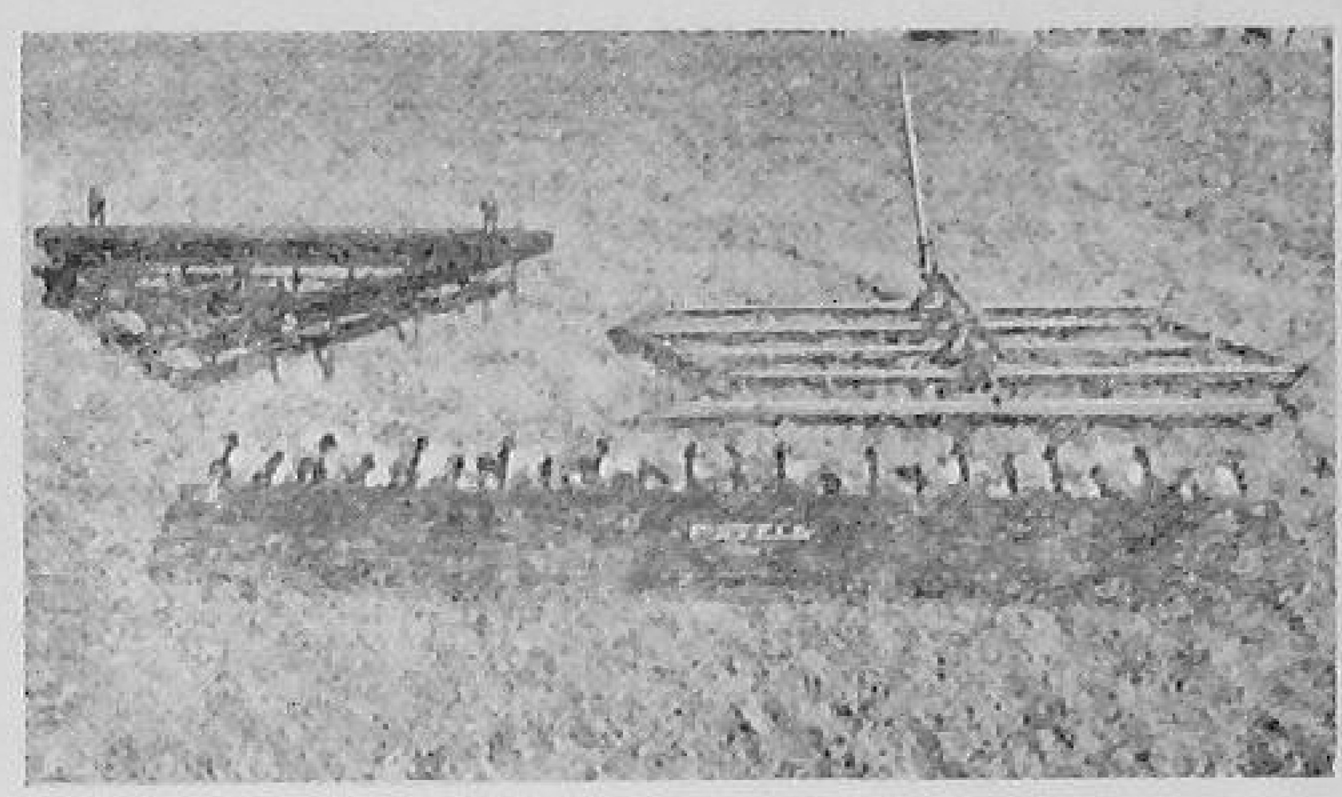


(Above) *A Disc Harrow and a Mould-board plough.* (Below) *A Triangular Harrow; an all-steel Spike-toothed Harrow; the Singh Patela*

T. H. NIRMAL & J. D. TRAYWICK

TODAY, there is available a good line of improved implements to cover most of the phases of maize farming.

For higher efficiency and wider area coverage, farmers should take to these improved implements. These implements are labour-saving and many are power-operated, and so can give maximum outturn with optimum loading on men and bullocks.

Some people believe that the modern implements are too heavy for our animals. This is not true. The modern implements come in varying sizes to suit different sizes of animals. It is up to the farmer to make the selection of matching implements for the animal he has.

A set of implements from those described here can make maize farming more profitable and, at the same time, remove much of the drudgery involved. Mostly implements for bullock and manual operation of current production models have been considered. Some suggested equipment and some for mechanized farming are also mentioned.

SEED-BED PREPARATION

For seed-bed preparation, mould-board ploughs are fast replacing the wooden ploughs in maize-growing areas. These give a thorough working of the soil in the first tillage operation itself, which is essential for the successful use of commercial fertilizers, which in turn depends upon a plentiful supply of organic matter in the soil. For turning under the green manure crops and other organic matter, the mould-board plough is the proper implement.

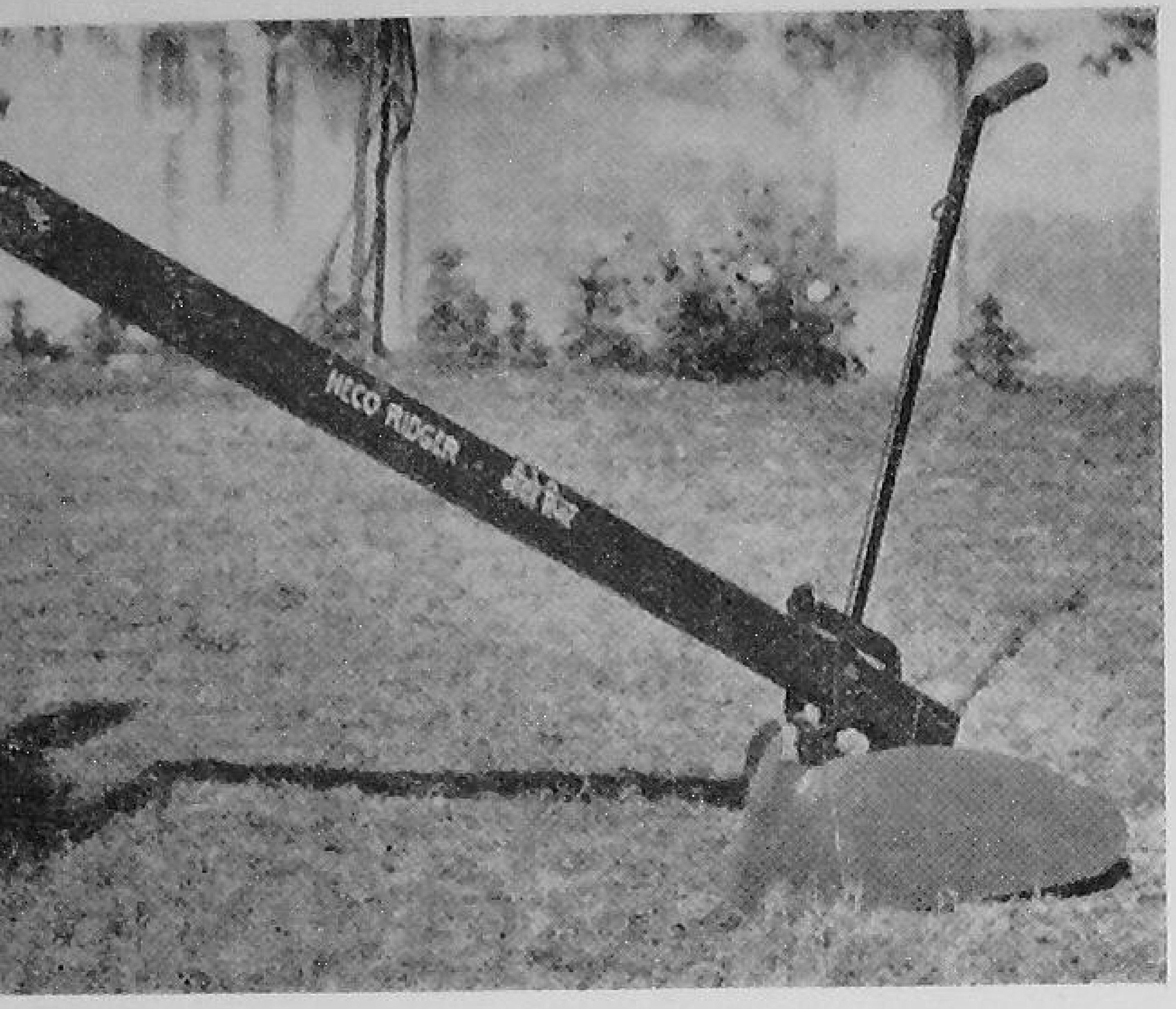
Some of the ploughs suitable for average-size bullocks are: Care Junior, Meston, Shabash, Wah-Wah, Konkan, Gurjar, Praja, Watt and Cooper No. 25. These can cover 1/3 to 1/2 acre per day.

Mould-board ploughs for heavy bullocks include: Hindustan, Care Senior, Vijaya, Cooper Nos. 25 and 26, Punjab and U.P. No. 2. These can cover 1/2 to 3/4 acre per day, and are to be preferred to the lighter ones for maize, as they work deeper.

For two-bullock operation, long wooden-beam ploughs are more convenient compared to the short-wooden or steel-beam ones.

Normally no more ploughings will be needed after working the mould-board plough once. This is so because the soil is already loosened up and you can safely engage your bullocks to carry out the second important tillage operation—working the land with a wide DISC HARROW.

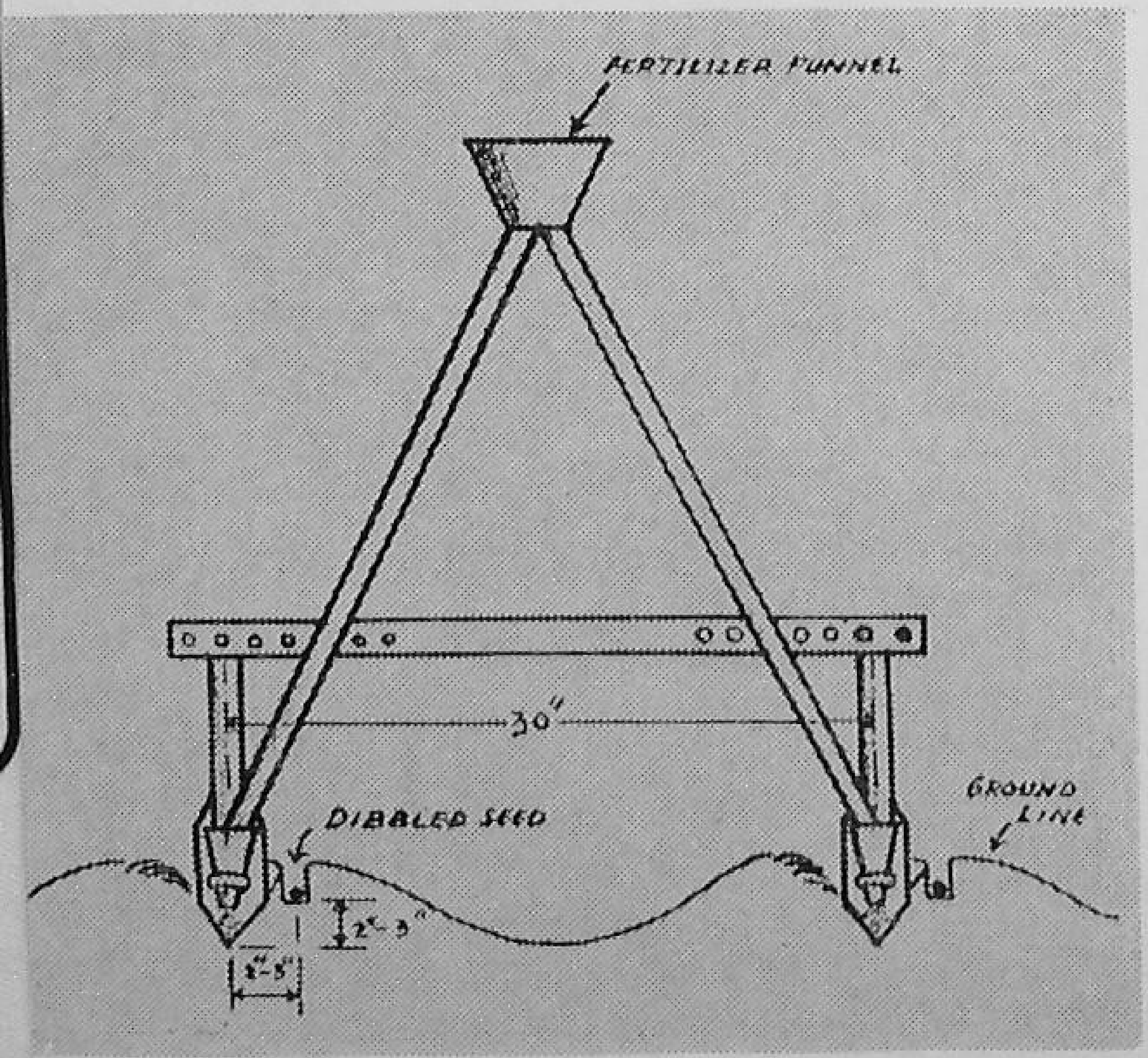
The disc harrow is no doubt comparatively an expensive implement, but it will prove to be worth the



A Ridger

investment. The harrow breaks the clods left during ploughing and cuts up the organic matter.

It can cover about four acres per day. Several good makes of disc harrows are on the market with eight 12 inches, 14 inches or 16 inches diameter discs. One with eight 14 inches discs is suitable for most



conditions. If found too heavy, one exterior disc from each gang should be removed.

For completing seed-bed preparation, either SPIKE TOOTH HARROWS or rollers and planks are recommended. In the all-steel spike tooth harrow, the cutting angle is adjustable. A cheaper version of the spike tooth harrow is the triangular harrow, with a wooden or metal frame. Its teeth are slightly curved but their cutting angle is not adjustable. These harrows can cover from three to four acres per day.

The SINGH PATELA with weeding hooks can work like a harrow, at the same time doing some compaction of the soil.

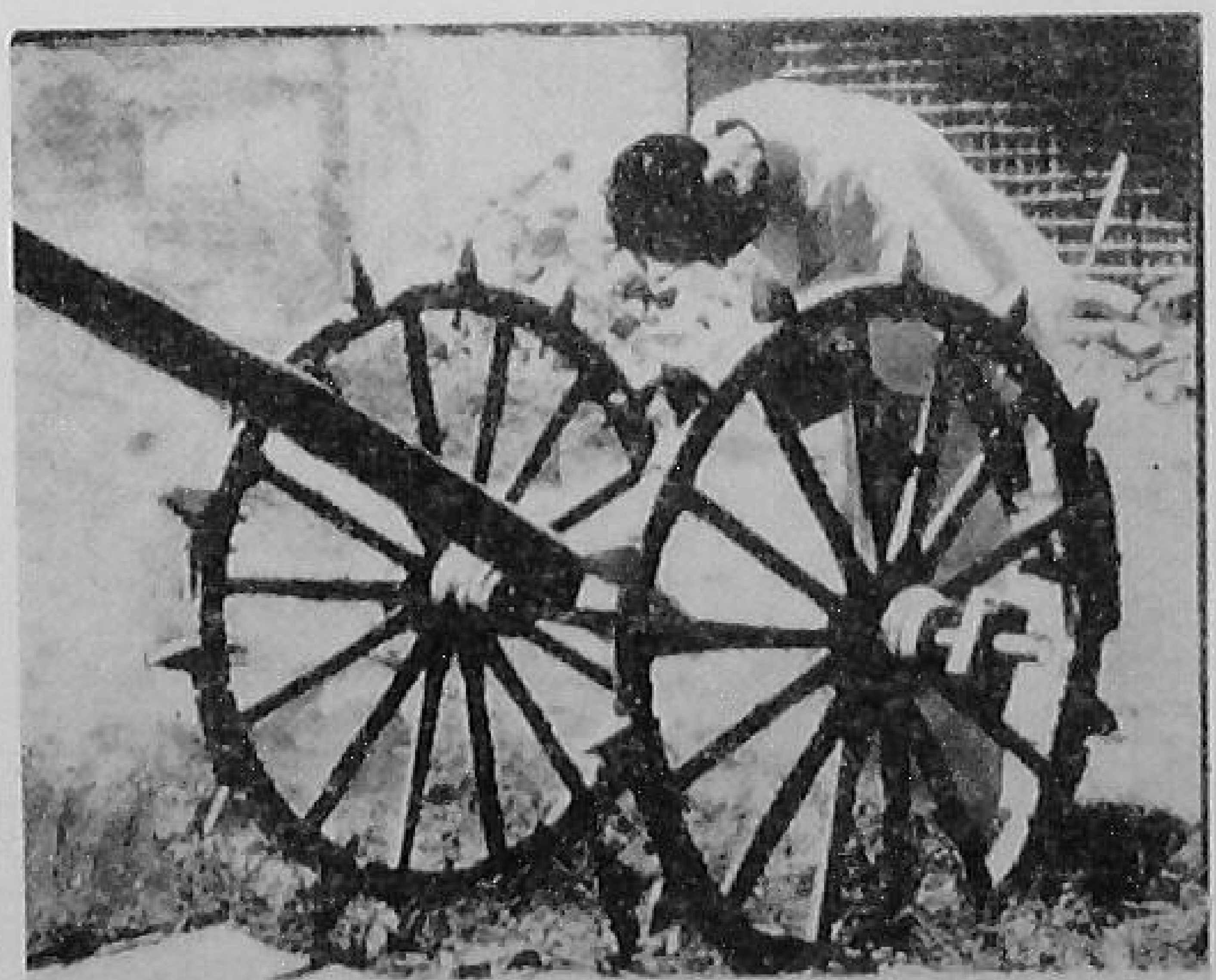
Ridging is the last tillage operation before planting and fertilizing. RIDGERS come as attachments for plough stocks or as separate implements, the former being cheaper.

SOWING AND FERTILIZING

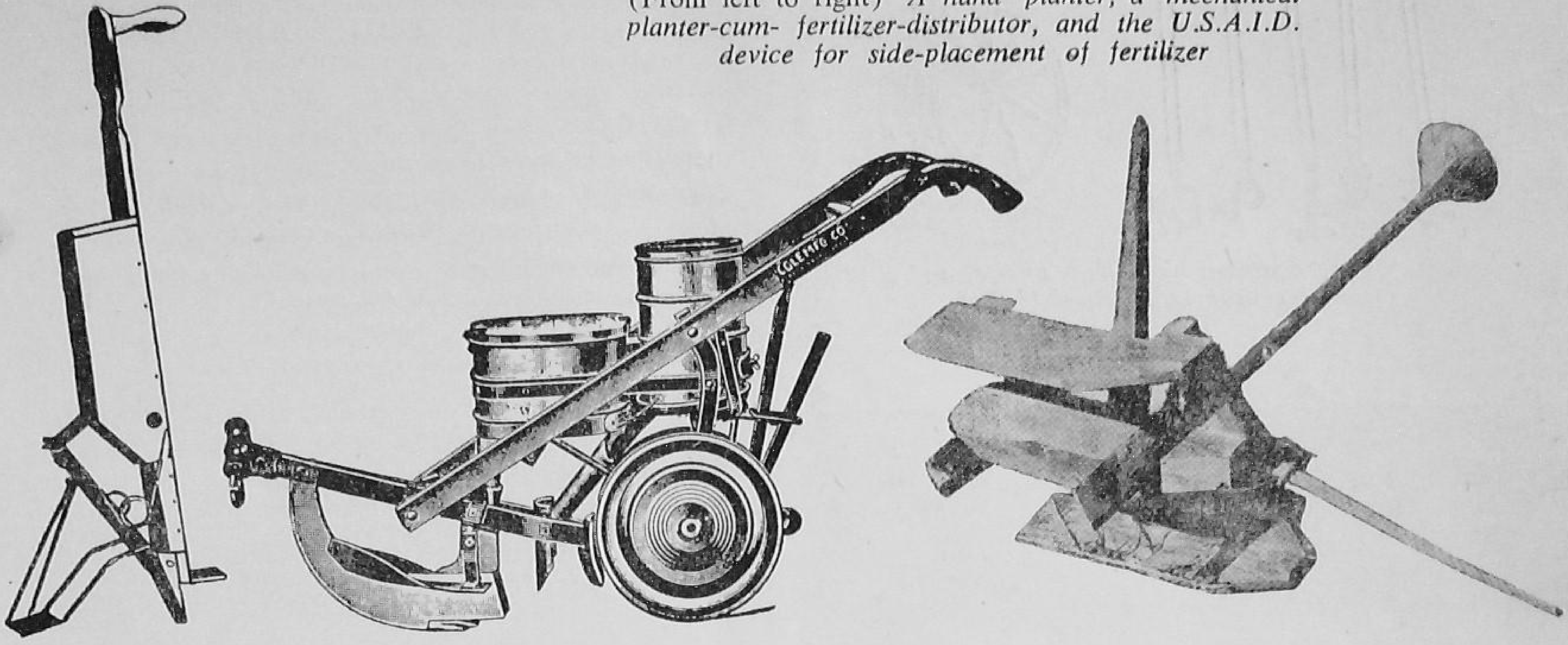
At present most of the sowing work for maize is done manually. Fully automatic maize planters with fertilizer attachment are not yet commonly available. To make hand-dropping of seed faster and provide even spacing of seeds, the two-wheel animal-drawn DIBBLER is useful. It can cover four to five acres per day.

If one does not have mechanical planters, dibblers to cover more than two rows can be fabricated for

(Left) *A Shovel-type Cultivator for side-placement of fertilizers.* (Below) *A two-wheeled Dibbler*



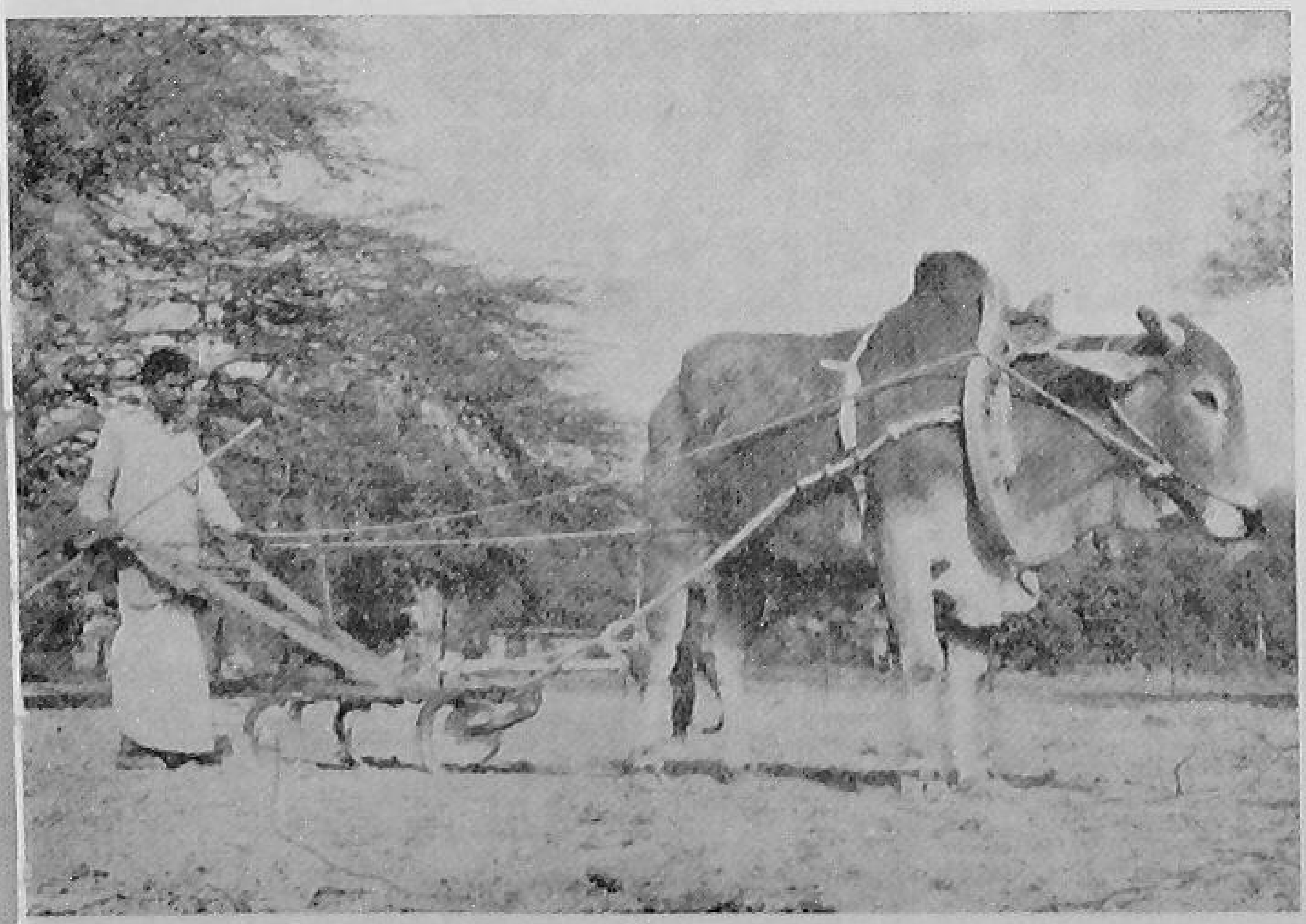
(From left to right) *A hand planter, a mechanical planter-cum- fertilizer-distributor, and the U.S.A.I.D. device for side-placement of fertilizer*



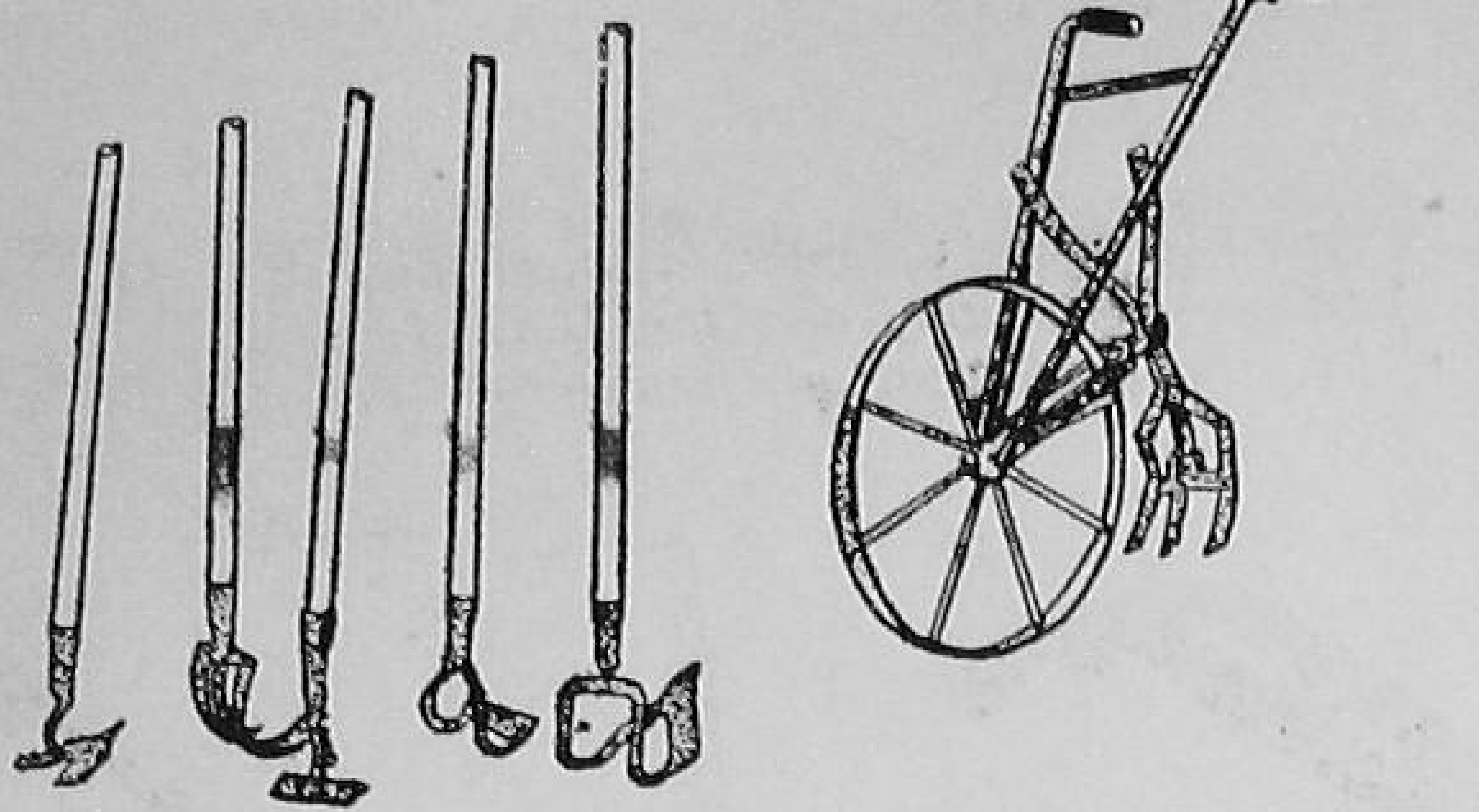
tractor operation. For initial plant growth, the first dose of fertilizer should be applied about three inches to one side of the seed and three inches below the seed.

Fertilizer application could be carried out by any of the following means. One way will be hand-dropping the fertilizer through the seeding arrangement of a shovel cultivator and then dibbling the seed beside the fertilizer furrow. Another could be using the fertilizer-dropping section of a machine like the Swastik SEED-CUM-FERTILIZER DRILL. The most positive method will, of course, be to use a mechanical planter with fertilizer attachment. For small-scale planting and for replanting skips, the HAND-PLANTER may be used. A device which can side-place fertilizer and leave an open furrow for the hand-dropping of the seed, is under development by the U.S. Agency for International Development.

Interculture Cultivator, pulled by a single bullock. Note the hitch and harness, being developed by the I.A.R.I.



Hand-operated Duster (left) *and Sprayer* (right)



Some of the common hand hoes in use, and a Wheel hoe with large wheel (right)

Application of water, using black polyethylene hoses

Single-and double-edged Billhooks for harvesting maize (right), *and the sugarcane harvesting knife* (left)

CROP PROTECTION

Once the plants emerge, they need to be protected against insects and diseases by spraying chemicals. This can be taken care of by using the hand-operated DUSTERS and SPRAYERS. Several good makes of various capacities are avilable. The ones shown here have a capacity of three to four acres per day. Farmers who command larger acreage can go in for animal-drawn and power-operated models.

WEED CONTROL

As the maize crop grows, weeds also start competing with the crop for plant nutrients and water. To protect the crop and assure higher yields, the fields should be kept free of weeds. CULTIVATORS come in handy for this purpose. Animal-drawn shovel cultivators such as the Wah-Wah Junior, Trifali, Akola hoe, Baroda hoe and Kanpur cultivator can also do the job, covering one row a time. The McCormic type cultivator fitted with a small six to eight inches wide furrower at the middle can leave a clean furrow suitable for irrigation. Coverage will be about two to three acres per day. In selecting a cultivator, the farmer should look for the one with a higher ground clearance.

When the plants are taller, the push type wheel hoes will be found useful for intercultivating the fields. Wheel hoe with larger diameter wheels (about 30 inches) work much smoother. To get at weeds quite close to the plants, the hand hoes of various designs are available to choose from.

IRRIGATION

The problem in irrigating row crops is that of letting the water from the field channel into the furrows. The time-honoured practice of cutting open the partitions and putting them back row by row is tedious and time-consuming. A simple device to overcome this difficulty is small syphon pipes made of rubber or plastics.

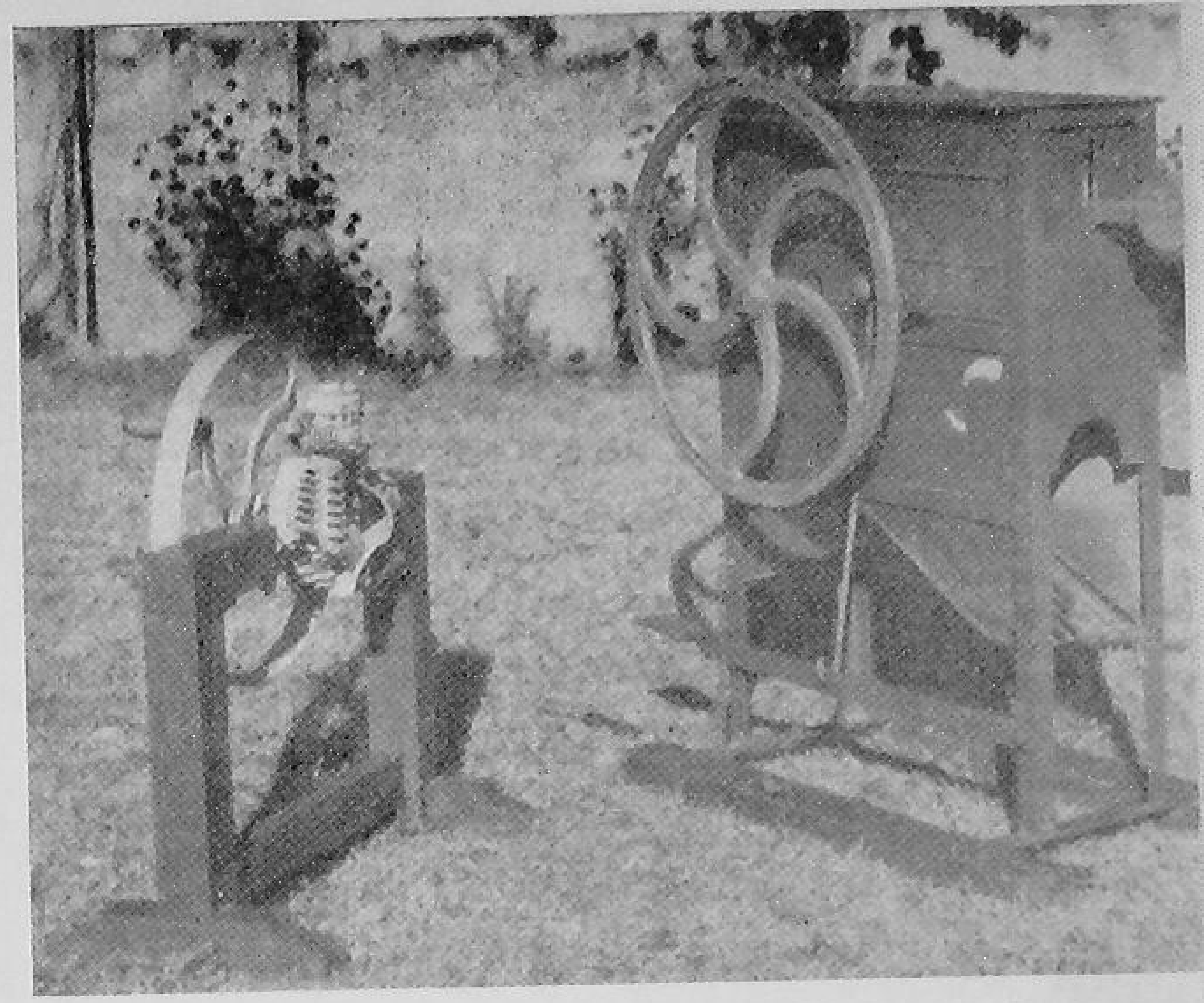
As mentioned earlier, using a small-size furrow-maker on the cultivator while doing interculture, could leave clean furrows to facilitate irrigation.

HARVESTING

No animal-drawn maize harvesters are yet on the market. So, the suggested procedure is to hand-harvest the maize cobs first and then cut down the stalks with heavy knives such as the BILLHOOK or sugarcane-harvesting knife. Good-quality billhooks of single and double edges are available and are to be preferred to *gandasa*.

SHELLING

Shelling maize for small farms can be done with hand or with pedal-operated machines. Some of these are adaptable for fractional horse-power electric motors.

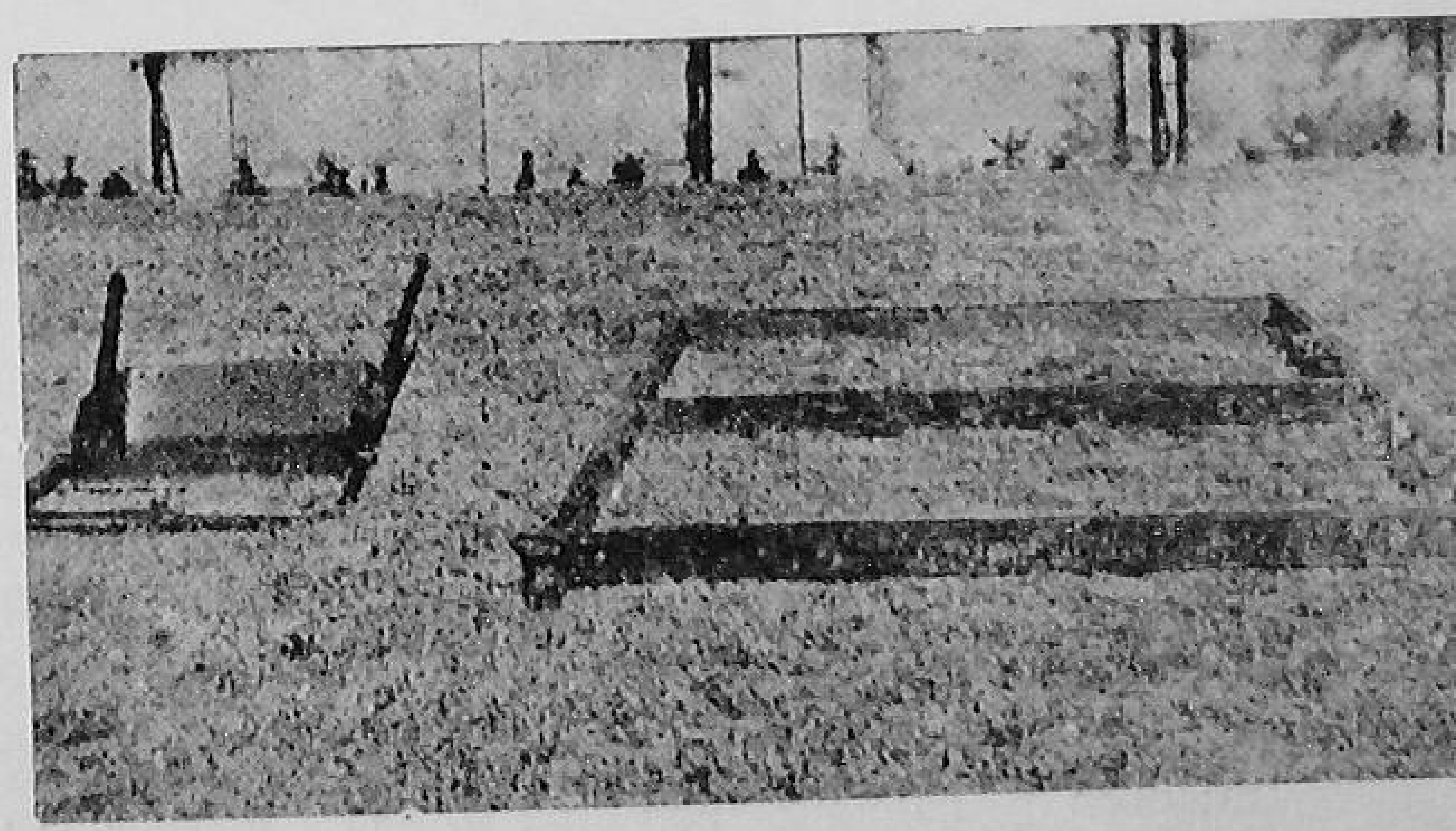


Two types of Maize Shellers now manufactured in India. The one on the right can be operated by hand or foot

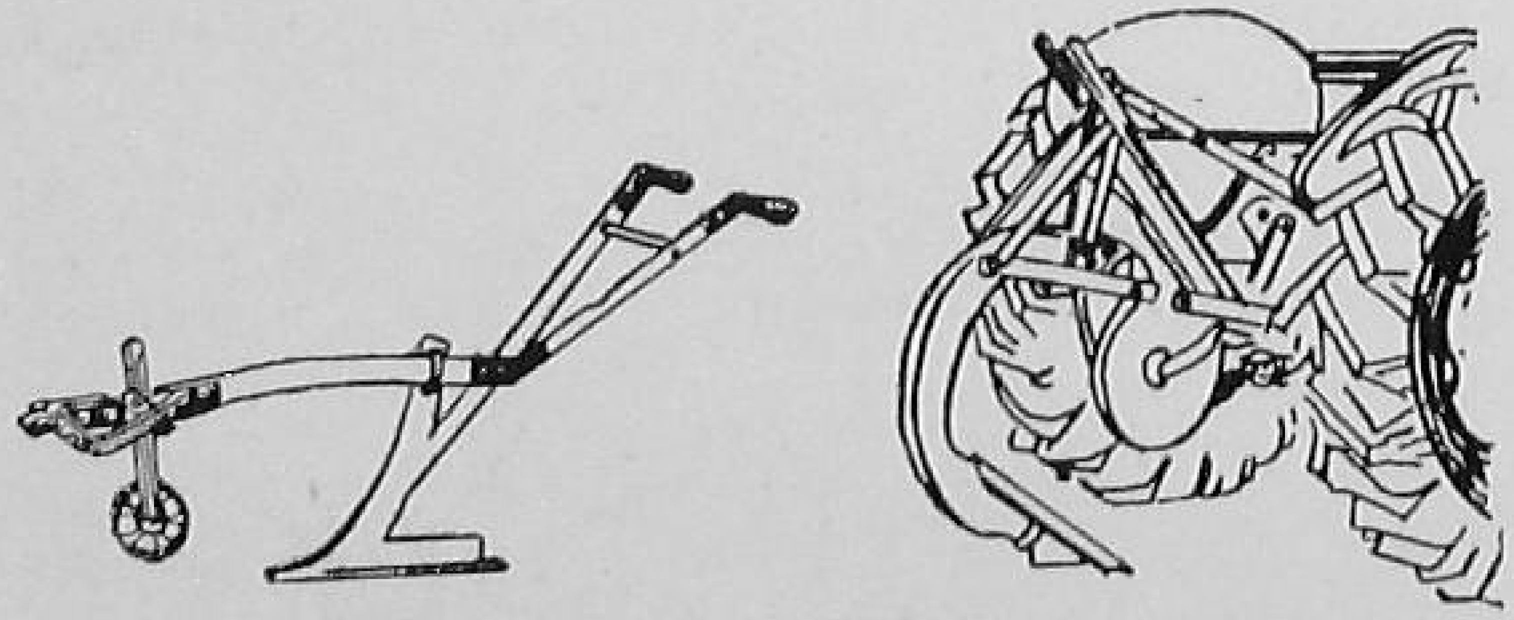
LAND SHAPING AND MANAGEMENT

Well-levelled fields make field operations easier and permit introduction of more labour-saving implements. More economical use of irrigation water and prevention of fertilizer loss by run-off will also be possible only on levelled fields. The animal-drawn BUCK SCRAPER and the BUCK LEVELLER can be used for shifting soil from higher spots to lower areas. The buck scraper holds the soil inside it and so can shift soil through comparatively longer distances. The buck leveller scrapes out soil from high spots and pushes it on to the lower areas. It is an ingenious tool with excellent manoeuvrability and works almost like a bulldozer. You should put these implements to full use during the slack seasons to bring the fields to a better shape. The IARI FLOAT is a land-smoothing device and can be used between planking and ridging. It can cover about five to six acres in a day.

(Below) *The buck scraper* (left) *and the float* (right)

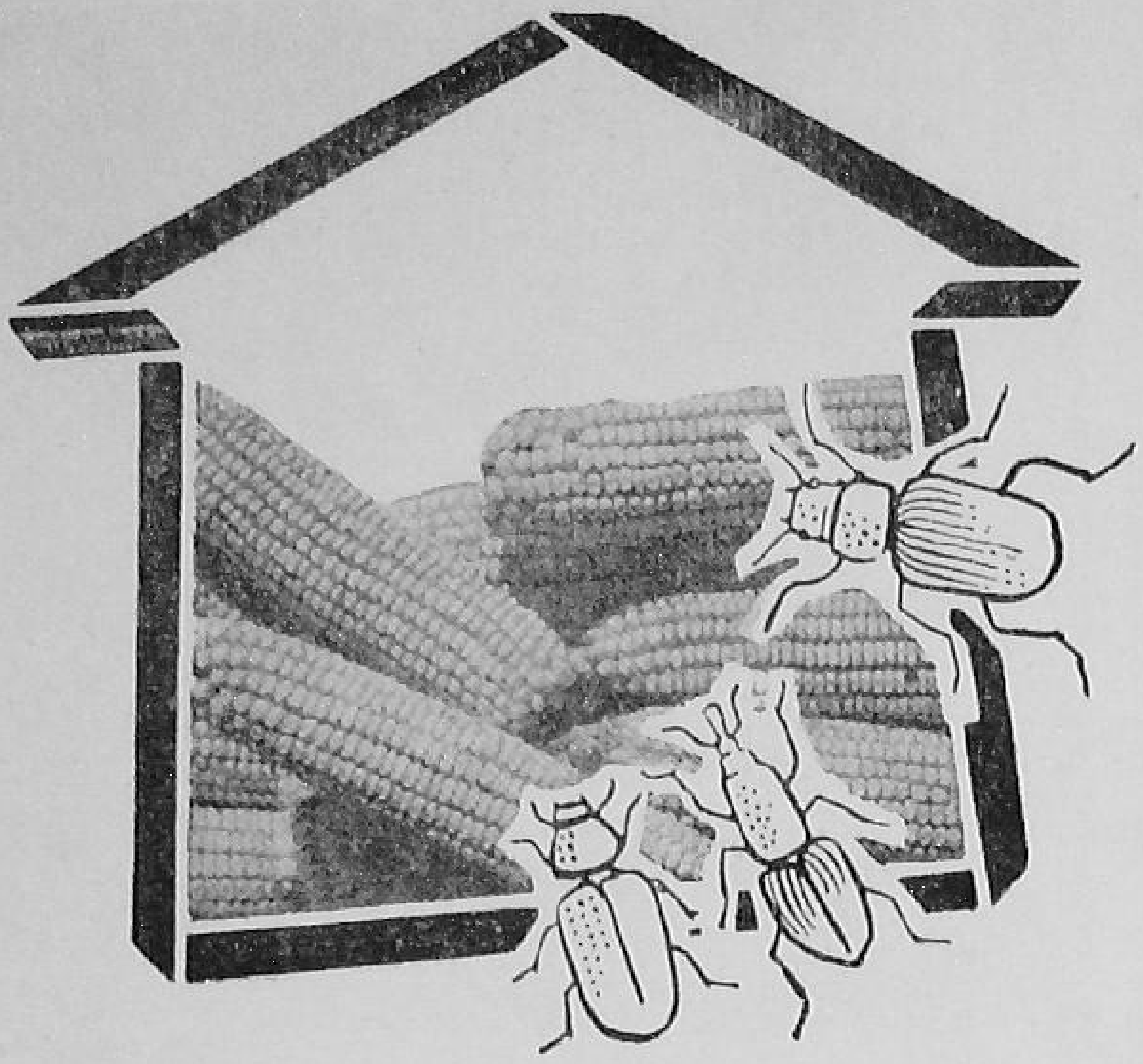


The SUB-SOIL PLOUGH may be used once every few seasons to break the subsoil. This could make the soil retain more moisture, provide a larger root zone for the plants, and prevent the formation of hard pan. The sub-soiler should be used behind the mould-board plough to get proper depth. A considerable increase in yields has been reported by the use of the sub-soiler.



Subsoil Plough : bullock-drawn (left) *and tractor-operated* (right)

Using their ingenuity, farmers often bring about improvements on standard equipment. They spend more time with the implements under field conditions and so could attempt modifications to overcome diffi-culties faced by them. Progressive maize farmers taking initiative in this direction could fire the imagination of other farmers as well.



PESTS CAN SPOIL MAIZE IN STORAGE

By D. B. REDDY

AFTER keeping maize grain in storage, very often you may find that a good amount of grain, if not all, is completely spoiled.

As a matter of fact, insects, rats and moulds, all spoil maize in storage. Moulds make the grain unfit for seed as well as for consumption. Amongst all these, insects cause the greatest loss.

You may wonder how a newly harvested crop is attacked by insects so soon after storing. Weevils and other storage insects live inside cracks and crevices in the walls, floors, ceilings, etc., of storage rooms, and attack the grains as soon as you put them in the store.

These insect pests also remain hidden in the storage receptacles. They can also come from the sweepings and rubbish lying near the store. They can hide under the matting and in the meshes and seams of bags. The new produce may be attacked by insects from the infested maize of the previous year. Sometimes, the new produce may get infested right in the threshing yard.

Hence you have to take all precautions to save your produce from these insect pests.

STORAGE INSECTS

Rice Weevil :

It is a small, dark brown beetle, with a long snout. It has four light reddish or yellowish spots on the upper surface of its body. The adult female bores a hole in the grain with its snout. Both the larva and the adult cause damage to the maize grains.

Borer Beetle :

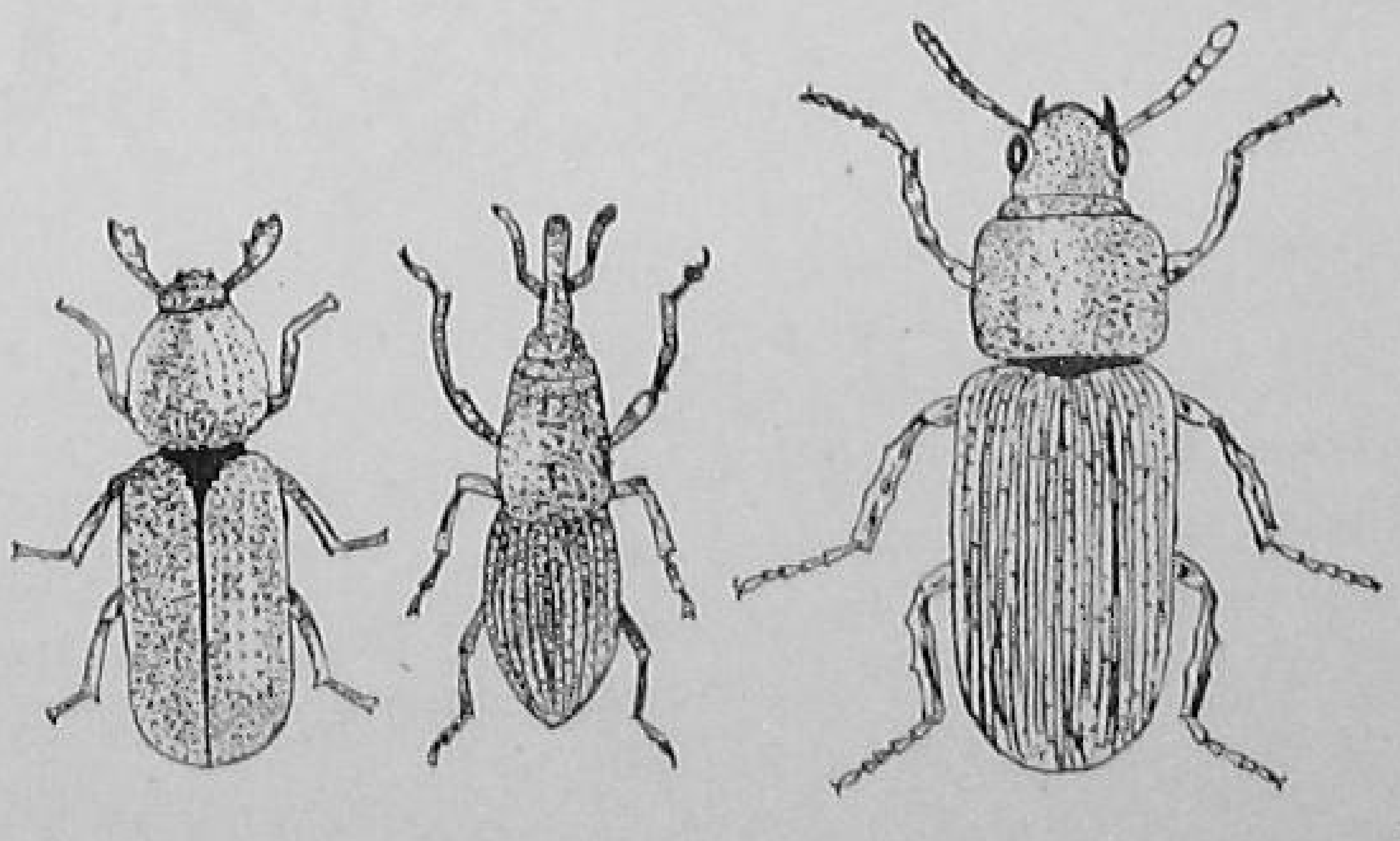
The beetle is dark brown in colour and cylindrical in shape. The head is bent. It is smaller than the rice weevil. Both the adult and the larva damage maize and other stored grains.

The other insects which attack stored maize are grain moth, rust-red flour beetle and saw-toothed grain beetle.

PRECAUTIONS TO TAKE

1. Store clean maize in a clean place. Before you store the produce in bags, earthen pots, *khattis, kothas,* underground pits, rooms, etc., see that they are thoroughly cleaned and the sources of infestation removed. Properly dispose of the cleanings and sweepings from the old stocks. Do not throw them near the store.

2. Fill up all cracks, crevices, etc., in the storage godown. Get it whitewashed. Disinfect it with an



(From left to right) *Grain beetle; rice weevil; borer beetle*

insecticide like BHC or DDT (0.4 per cent) at 1 gallon per 100 square feet.

3. Dry maize properly in the sun before storing. Maize with a moisture-content higher than 10 per cent is easily attacked by insects. Moulds also attack the grains if they are not dried or if the godowns are damp and hot.

4. Do not mix the new produce with the one which has been in storage for some time.

5. Do not keep the storage bags, pots, etc., in places where they are exposed to high humidity and splashes of rain. The godowns should be damp-proof, leak-proof and rodent-proof.

6. Place the storage receptacles or bags on a dunnage of seasoned wood, bricks or stones.

7. Where possible, sun-dry the grains periodically. This will reduce the chances of infestation.

8. Inspect the stored maize frequently, especially during the rainy season. If you notice any insect attack, take control measures in time.

MEASURES FOR CONTROL

In case of infestation, take the following measures :

1. Use EDCT mixture at the rate of 30 pounds per 1,000 cubic feet of space or methyl bromide at 1 to 2 pounds per 1,000 cubic feet of space.

Fumigation should be done by experienced persons.

2. Dust lightly the outside of the bags and the storage receptacles with 5 per cent BHC at the rate of 8 ounces per 100 square feet of area, to prevent entry of insects from outside.

Do not mix the insecticides with the grains.

HOW TO CONTROL RATS

Rats spoil more grain than they actually consume. They make burrows in *kacha* houses, and store a lot of grain in these burrows. They are found causing loss throughout the year.

To control rats, you have to take measures regularly. Use traps and poison baits. But poison baiting should be done only under expert advice and by experienced persons. Under no circumstances should poison baits be allowed to get mixed with the grain.

Hybrid-Maize Pleases Andhra Farmers

By M. SANKARA RAO

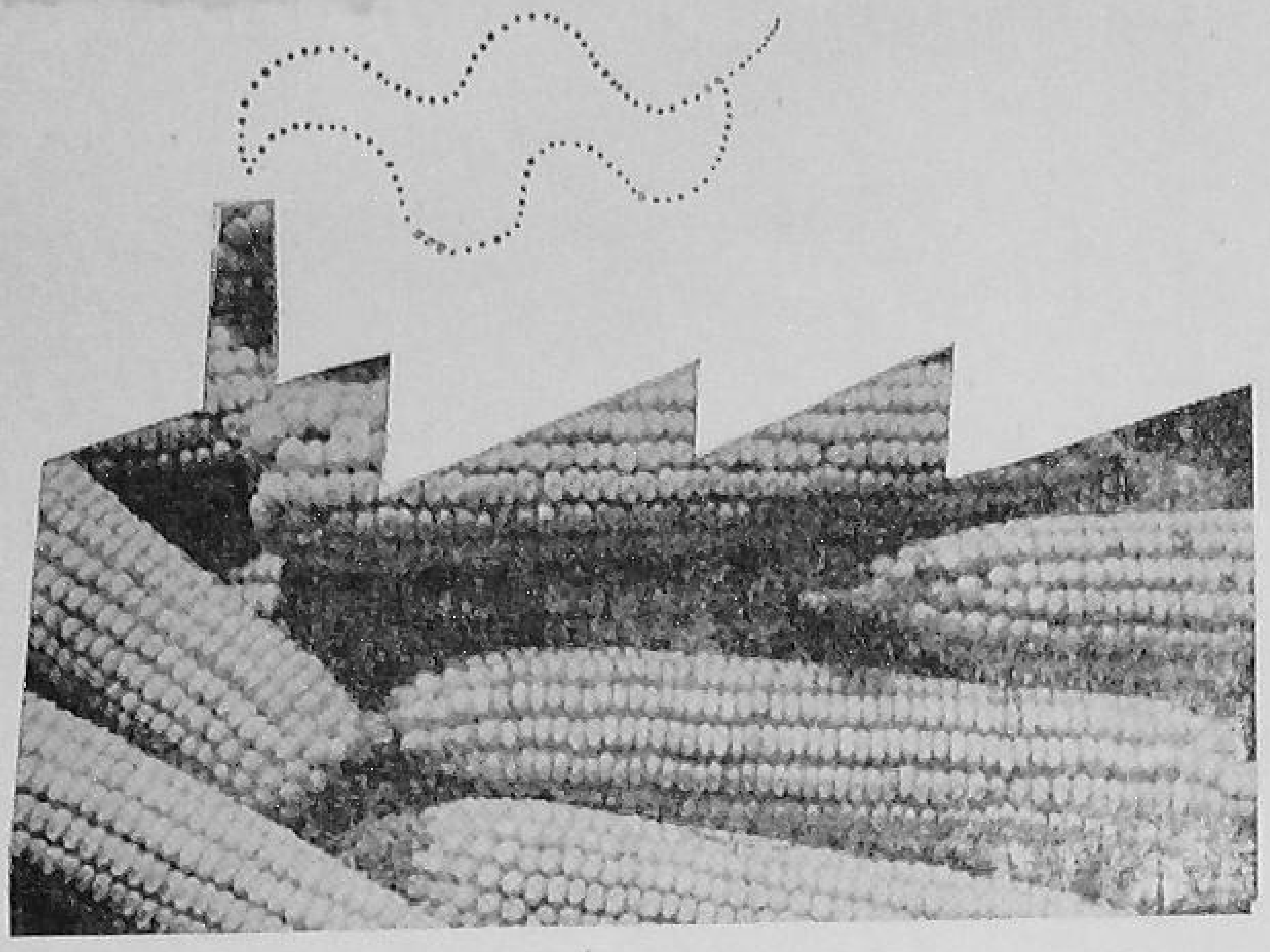
MAIZE growers in Andhra Pradesh are now fully convinced that the *Deccan* hybrid *makka* they grow yields high. They also feel now that they can get the best results if they grow hybrid maize under high fertility conditions. Most maize-growers apply chemical fertilizers at 45 pounds N (nitrogen) and 25 pounds P_2O_5 (phosphate) per acre. Quite a large number of them adopt recommended practices and thus obtain still higher yields.

Growers now take up the cultivation of hybrid maize under irrigation in the *rabi* season, since they have all the necessary conditions for assured yields. In the *kharif*, maize is generally grown on a large scale in lighter soils under rainfed conditions but without giving adequate manure to the crop. Because of the vagaries of nature in the *kharif* season, growers who have fertile soils and irrigation facilities for early plantings, are taking up sowing of hybrid maize. And since the high yields from hybrid maize are earning attractive profits for them, maize growers are slowly shifting to hybrid maize from other crops.

In some maize-growing tracts, farmers rotate the cash crop of chillies with maize in the *kharif*. Since they have to transplant chillies in the last part of September, they raise early-maturing maize, taking advantage of the early rains in the first fortnight of June, and transplant the chillies in the same field just before the maize is harvested. If, however, the monsoon sets in very late, they forgo the growing of maize and prefer the growing of chillies.

In *rabi*, maize-growing gets better attention and, since it is grown largely irrigated, growers are increasingly taking to hybrid maize which yields high. But even here, because of *Deccan* hybrid *makka* being a late maturer than the early local maize by about 20 to 25 days, many small growers take to the early but poor-yielding local varieties. This also is due to the inadequate water resources they have in their small wells.

(*Continued on page 39*)



Maize has a place in Industry

By G. V. CHALAM and V. M. SAHNI

MAIZE is grown in India as the poor man's crop. But in countries like the U.S.A., it is an agricultural crop of great importance. It constitutes a major part of the diet of the people in one form or another, and furnishes raw material for a variety of industrial products.

No part of the plant is a waste. The most common use in Indian homes especially in the north is the *roti.* Maize is also taken in the form of parched grains. Roasted ears are also taken. The straw is used as roughage for cattle.

In industrially advanced countries, maize occupies an important position. It yields more products than any other grain. All the parts, such as stalk, leaves, silk, cob and, above all, the grain have a use in industry.

The husks of the ear are used as wrapper. The stalks and leaves are used for making paper, wall-board, paper board, mattresses, cellulose products and packing material. Maize cobs are used as fuel, cork substitute as well as for cleaning furs, polishing metals, removing carbon from petrol and diesel engines and grease from tins and maize cob pipes.

The maize grain contains 55 per cent starch, 26 per cent gluten, 3 per cent oil and 16 per cent water. The following are the various uses of starch and of the products derived from it, viz. syrup, sugar and dextrin.

STARCH

Adhesives
Bakery products and baking powder
Brewing
Confectionery
Cosmetics
Desserts
Explosives
Laundry and textiles
Paper and paper boxes

SYRUP

Industrial	*Food*
Adhesives	Bakery products
Leather tanning	Brewing
Pharmaceuticals	Canned fruits
Special Type paper	Chewing gum
Textiles	Confectionery
Tobacco	Ice creams
	Jam and jellies
	Mixed syrups
	Soft drinks

SUGAR

Refined Sugar (Dextrose)	*Industrial Sugar*
Bakery products	Brewing
Carbonated beverages	Fermentation
Canned fruits	Rayon
Confectionery	Tanning
Dessert product (Power)	Tobacco
Ice-creams	Vinegar
Jam and jellies	
Pharmaceuticals	

DEXTRIN

Adhesives

GLUTEN

Mostly used as cattle and poultry feed

OIL

Carrier for certain insecticides
Cooking oil
Leather dressing

Maize oil-meal
Oils
Pharmaceuticals
Salad and table
Soaps
Vanaspati

MEDICINAL USES

Corn oil used as carrying agent for vitamins
Dextrose used for dietetics, intravenous injections and other prescription compounds
Infant feeding in the form of syrup
Soluble for gluten feed
Starch used as binder and extender for tablets
Steep water (water in which maize is soaked or boiled in wet milling) used as food for pennicilin and other antibiotics moulds and bacterial food.

LIVESTOCK USES

Feed grain—whole or broken
Fodder
Maize bran
Oilcake
Silage

This long list of the industrial uses of maize shows its importance in the economy of the advanced countries of the world. This also points to the role which hybrid maize is going to play in the future economy of our country.

HYBRID MAIZE PLEASES ANDHRA FARMERS

(*Continued from page 37*)

Farmers now feel that *Deccan* hybird *makka* is almost like the local in grain quality and taste. Earlier, they had tried the U.S. hybrid for a few seasons, which had created a feeling that hybrid seed was flat in taste. With the *Deccan* hybrid *makka* introduced into the villages, the prejudice against hybrid grain still stands in the way of people readily accepting *Deccan* hybrid *makka* for consumption. This prejudice, however, will disappear in the next three or four seasons, when the cultivation of *Deccan* hybrid *makka* would have spread widely. The price factor will similarly improve for the hybrid.

To obtain higher yields, hybrid-maize growers are adopting improved cultural practices such as proper spacing, ridge and furrow method of planting to facilitate drainage, proper method and time of application of fertilizers, and timely plant protection measures. These improved practices are also being demonstrated to the farmers.

Farmers know HYBRID MAIZE PAYS

In the *rabi* of 1961 my *Deccan* hybrid *makka* gave me an yield of 31 quintals per acre, as against the 20 quintals per acre the local variety used to yield in the same field in the previous seasons.

The hybrid not only grows more vigorously than the local variety, but it is also able to resist pests better than the local.

—K. Govind Reddy, Jangampalli, Huzurabad Taluk, Karimnagar District, Andhra Pradesh.

* * *

Deccan hybrid *makka* is better than *Texas 26*, which again is better than the local maize.

In the 1961 *rabi*, the *Deccan* hybrid *makka* yielded 19 quintals (4,180 pounds) per acre, giving me a net profit of Rs. 300 per acre. *Texas 26* in the earlier years gave me an average of 17 quintals per acre and the local averaged 12 quintals per acre.

—A. Vishwanath Reddy, Bhimdeverpalli, Huzurabad Taluk, Karimnagar District, Andhra Pradesh.

* * *

I grew *Deccan* hybrid *makka* in the *kharif* of 1961. I applied 25 pounds of P_2O_5 per acre before planting; ammonium sulphate in three equal doses of 22 N per acre at planting, at knee-high stage and at flowering. The crop was free from the leaf-blight disease which the local variety very easily gets. I obtained from the hybrid an yield of 18 *pallas* (54 maunds) per acre. In grain quality and taste, *Deccan* hybrid *makka* is just like the local.

—N. Ramachandra Reddy, Papayapalli, Huzurabad Taluk, Karimnagar District, Andhra Pradesh.

* * *

In *rabi* 1961 I raised *Deccan* hybrid *makka*, and got 21 *pallas* (63 maunds) per acre, when the local had completely failed in the area.

AGRICULTURAL FILMS

Films and filmstrips are good Extension aids. If you want them for use in your teaching or field work, you can borrow them from the Farm Information Unit of the DIRECTORATE OF EXTENSION.

The Unit maintains a Library of Films and Filmstrips on Agricultural and Home Science subjects.

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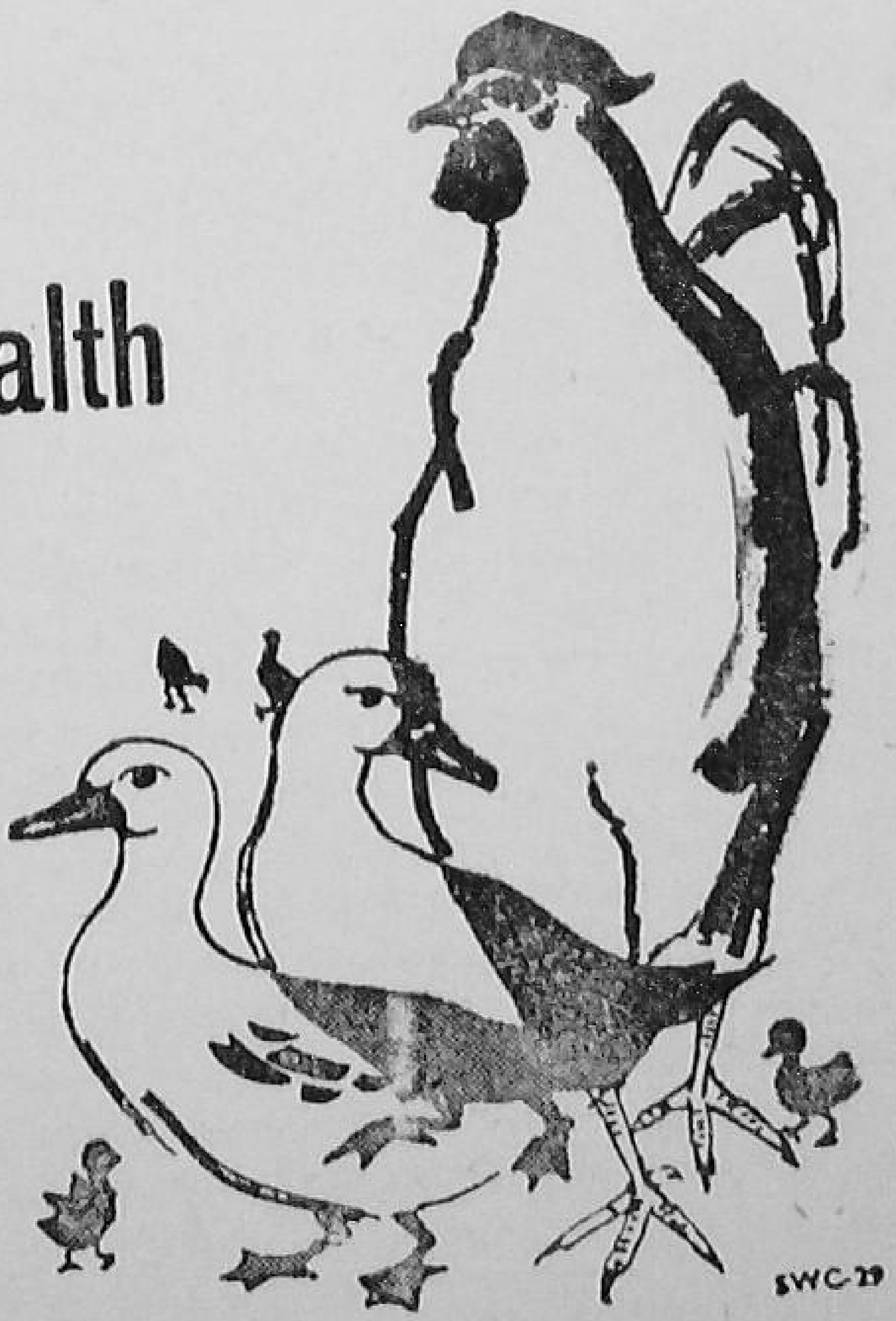


The land was fallowed during *kharif* 1961. After it was sheep-penned, it was ploughed five times. I applied 15 cart-loads of compost, 70 pounds of nitrogen, 30 pounds of P_2O_5 and 40 pounds of potash. I dibbled the seed in November with a spacing of 1 foot x 1½ feet. Worked *guntaka* after 20 days of planting, for earthing up. Spread nitrogen 20 days after sowing and again 2½ months after sowing. I harvested the crop in the last week of February 1962.

—Krishna Reddy, Mylavaram Village, Warangal District, Andhra Pradesh.

* * *

One good thing about the Deccan hybrid maize, apart from its high yield (I got 5,120 pounds per acre), is that it is like the local in grain-quality and taste. I grew the hybrid on 10 acres in the *kharif* season of 1961, and 12 acres in the *kharif* of 1962. More farmers should now go in for planting hybrid *makka*.

—E. Anna Reddy, Vavilala, Huzurabad Taluk, Karimnagar District, Andhra Pradesh.

* * *

The *Deccan* hybrid *makka* I grew last year gave me 15 quintals of yield per acre, as against 8 quintals which the local gave under similar cultivation. If the present dislike for the hybrid by some people for its appearance and taste is got over, the hybrid has a great future.

—S. Surendra Reddy, Maripeda Block, Warangal District, Andhra Pradesh.

* * *

I have been having hybrid maize trials on my farm for the last two years. The hybrid has given me 2½ times more yield than *desi* maize. Farmers who have visited the farm and seen the hybrid maize are now asking for seed which I am trying to supply so that the hybrid maize may spread.

This year I produced and distributed 100 pounds of hybrid maize seed to farmers.

—Manager, Mundia Farm, P.O. Baheri, District Bareilly, Uttar Pradesh.

* * *

Ganga 1 hybrid has given on my farm an average yield of 32 maunds as against 14 maunds of *desi*.

—Ch. Ram Chandra Singh, Farm Superintendent, Western Block, Malkota, Rudrapur, District Nainital.

* * *

My experience with hybrid maize is very encouraging. On an average, my per-acre yield of shelled dried grain turned out to be over 40 maunds, in spite of the crop having been affected by heavy rains during the late stage of growth.

—Gurcharan Singh, Village Turan, Tehsil Amloh, District Patiala, Punjab.

* * *

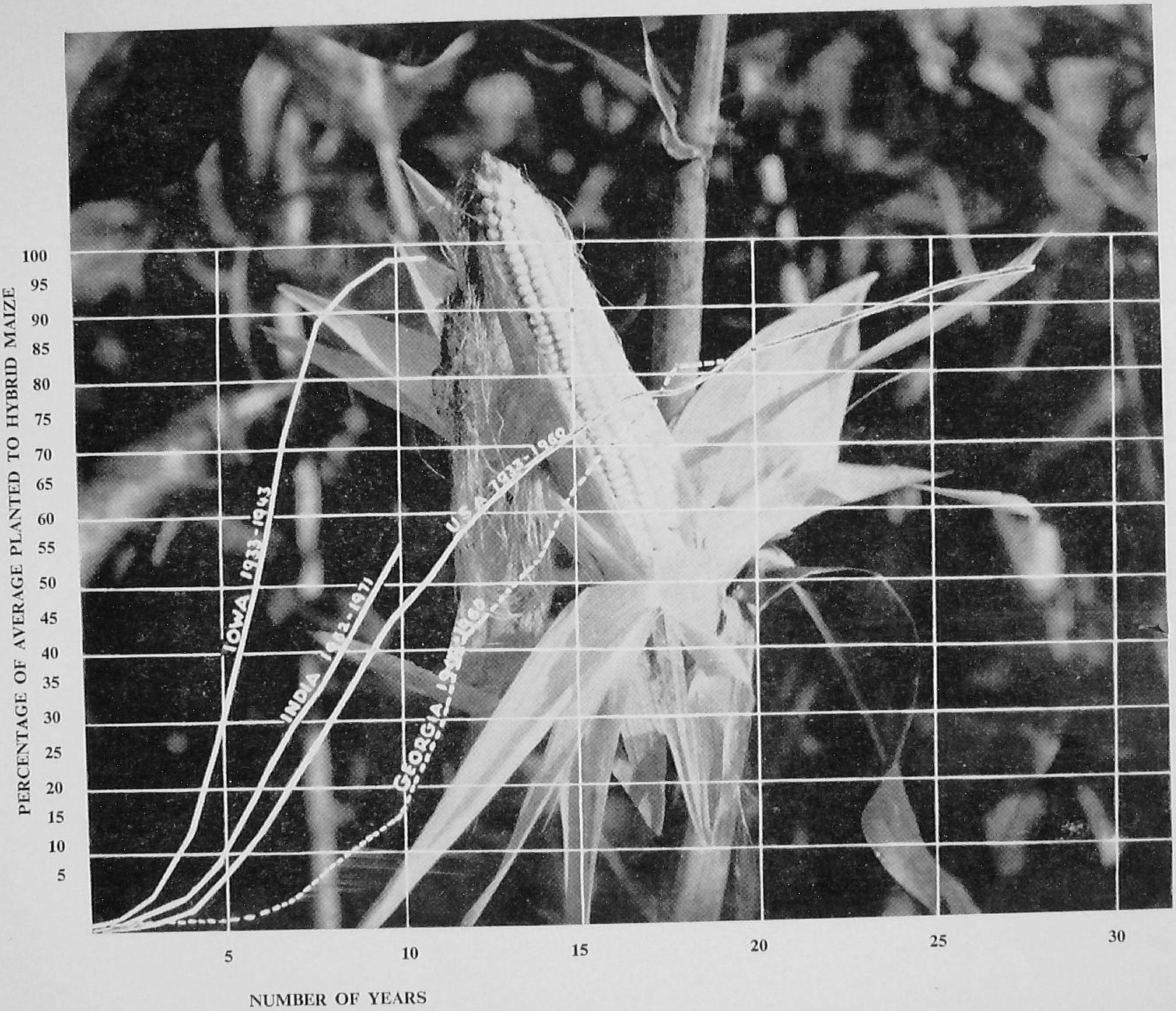
Hundreds of farmers were attracted by the lush green crop of maize in my fields last year when I tried *Ganga 101* hybrid for the first time. The crop yielded 50 maunds per acre. Now all the farmers in my area have decided to sow hybrid maize in the coming season.

—Ajit Singh, Village Daudpur, Tehsil Samrala, District Ludhiana, Punjab.

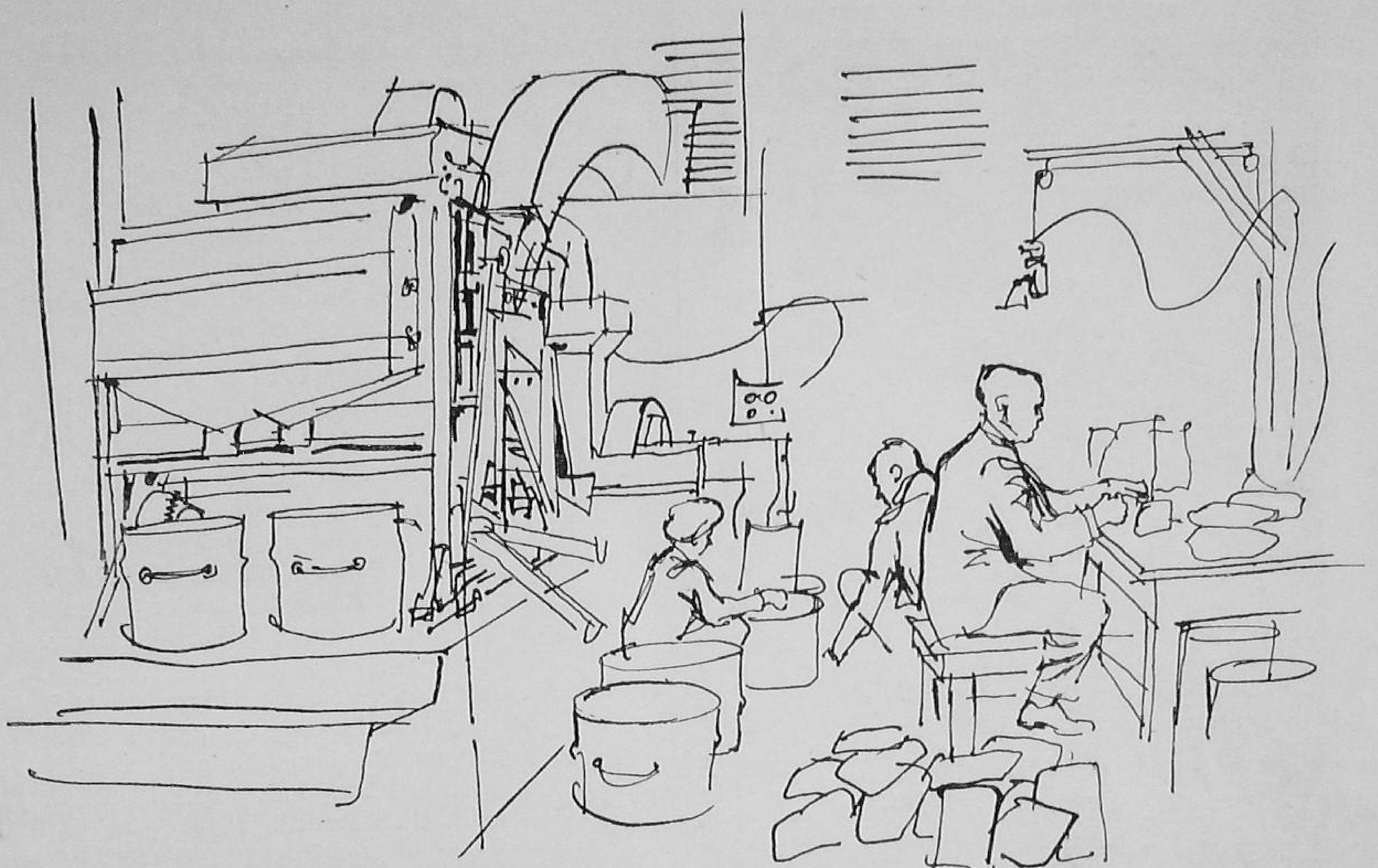
* * *

My experience with *Ganga 101* maize should put to rest any doubts about its taste. *Chapatis* prepared from this hybrid, I find, are softer and sweeter than those of *desi* maize.

—Ujagar Singh, Village Jassan, District Patiala, Punjab.



Hybrid Maize is getting popular



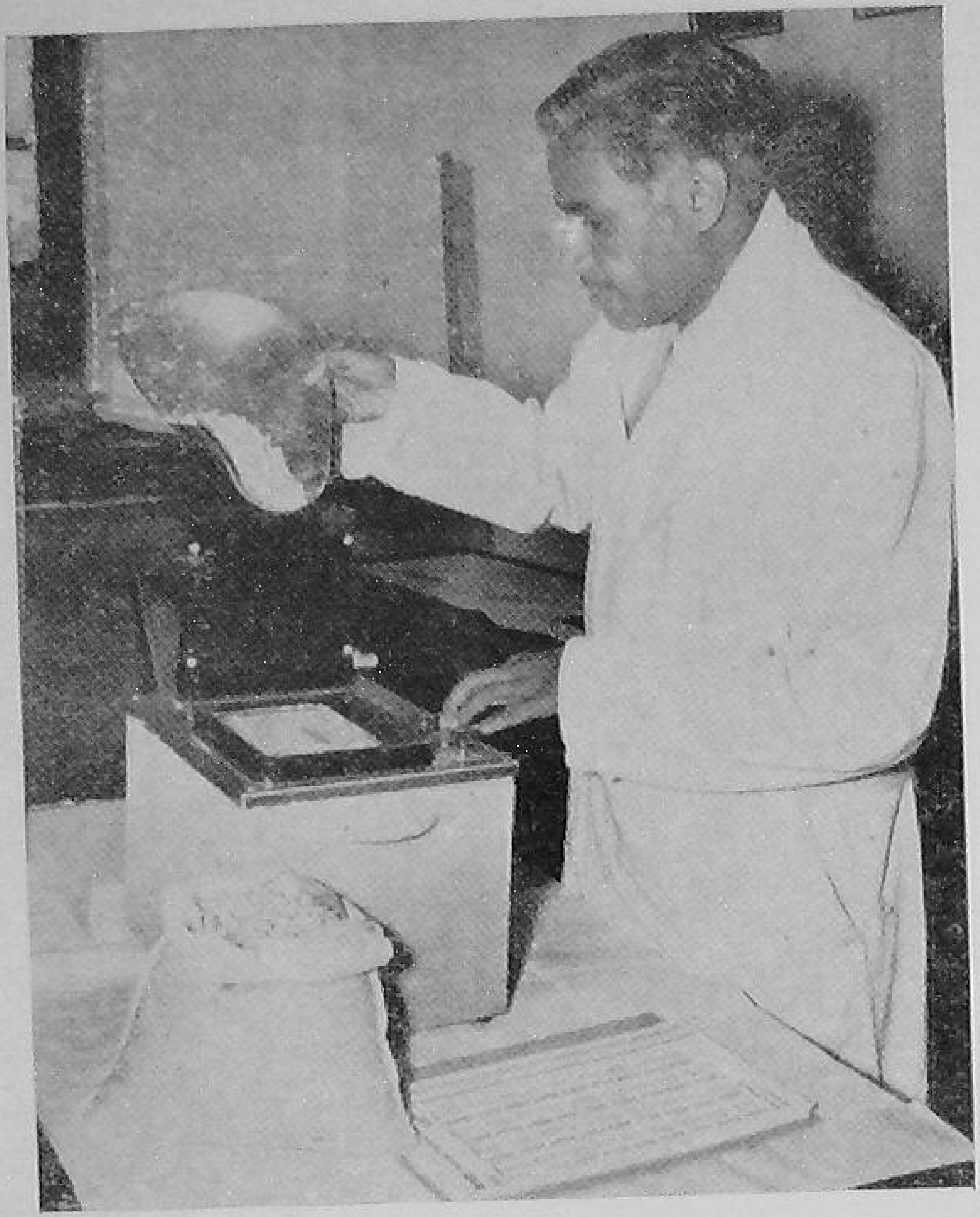
The Private sector and the seed industry

By B. S. DHILLON

A GREAT deal of work has been done by the Indian Council of Agricultural Research with the co-operation of the States and Indian Agricultural Research Institute, New Delhi, in evolving new hybrids, including hybrid maize. At the moment, five maize hybrids adapted to different regions have been released to enable farmers in all parts of the country to sow hybrids suitable for their own areas.

To enable farmers to use only hybrid seed, however, double cross seed production and distribution in very large quantities will be needed. This will mean the need of a going business with service motives, as is the case with other commodities. An enterprise solely engaged in the seed business will readily be able to concentrate on the various aspects of the industry—investment, production, processing and sales. On these depends its own development and also the effectiveness of its service to the cause of the country's agriculture. For, production of double cross seed depends upon the facilities available for processing and the arrangements made early enough for disposing of the produce expected. This production has to be correctly assessed before implementing the production plans. 'Hunting' for buyers after the seed is produced will only result in longer periods of seed storage, which will lead to loss of vigour and viability of the seed. If surplus seed stocks are possible, the provision of 'risk capital' will be necessary.

While seed production is seasonal, sales efforts have to be made throughout the year by trained personnel; demonstrations in the fields have to be laid out and an educational programme for cultivators and



A hybrid maize seed sample being given electronic moisture test

the public, undertaken. These sales efforts are not justified until the quality of the seed is ensured. There should be a healthy competition within the sector in trying to serve farmers with the best seed possible.

Our infant seed industry presents a challenge to the private sector. Its growth and development calls for land resources, capital investment in equipment, quality control and educational programmes and merchandizing. In this, the key role has to be played by the private sector as has been pointed out by the Committee which prepared the report 'Improved Agricultural Seed—With emphasis on Hybrid Maize.' It is certain that the private sector will live up to its obligations to the seed industry.

Beware of imitations. Always buy seed from authorized dealers.

WHERE TO GET HYBRID MAIZE SEED

If you are growing hybrid maize, you will have to buy fresh seed every year so that you may get the "hybrid vigour" in the seed. The following is a list of seed producers of hybrid maize. Your District Agricultural Officer will also be able to help you find out your nearest source of seed supply.

Ganga 101

(1) Assistant Seed Production Officer, PWD Rest House, Mandi Gobindgarh, Punjab.
(2) U.P. Agricultural University, Pantnagar Farm, Pantnagar, District Nainital, Uttar Pradesh.
(3) Agricultural Research Station, Dholi, Bihar.
(4) Agricultural Research Station, Dhaula Kuan, District Sirmur, Himachal Pradesh.
(5) Agricultural Association Pvt. Ltd., Connaught House, Connaught Place, New Delhi.
(6) Messina Joint Farming Cooperative Society, Samastipur, Darbhanga District, Bihar.
(7) Mundia Farms, P.O. Baheri, District Bareilly, Uttar Pradesh.

Ganga 1

(1) Assistant Seed Production Officer, PWD Rest House, Mandi, Gobindgarh, Punjab.
(2) U.P. Agricultural University, Pantnagar Farm, Pantnagar, District Nainital, Uttar Pradesh.

Ranjit

(1) Indian Council of Agricultural Research, E-19, South Extension Part II, New Delhi.
(2) Ummedganj Mechanized Farm, Kota, P.O. Kaithoon, Rajasthan.
(3) Pandya Farms, Dohad, District Panchmahals, Gujarat.
(4) Shri Jangjit Singh, Mori Bera, Pali District, Rajasthan.

Deccan

(1) Assistant Seed Production Officer, Huzurabad, District Karimnagar, Andhra Pradesh.
(2) Pandya Farms, Dohad, District Panchmahals, Gujarat.
(3) Manjri Farm, Gram Sevak Training Centre, Poona, Maharashtra.

Isn't Maize your favourite yet ?

By S. DANTYAGI

MAIZE forms an important cereal in the diet of our rural families. It is a rich source of energy-building elements like carbohydrates, and contains appreciable quantities of proteins and other protective elements like vitamins and minerals specially calcium and iron.

In India the flint types are used as roasted cobs (in place of sweet corn) and for *chapatis* or *rotis*. *Makki-ki-roti* and *Sarson-ka-sag* with butter or *ghee* is the popular combination in north India, and is truly a delicacy.

In our rural homes maize preparations are popular, and differ not only from region to region but also from family to family. Each family has its own culinary art and every skilled housewife, with her dextrous hands, makes her own exclusive tasty dish.

Given below are a few of the favourite tried-out recipes presented by our various Home Science Wings in the different regions of India. We hope you will find them interesting additions to your kitchen adventures.

ROTI

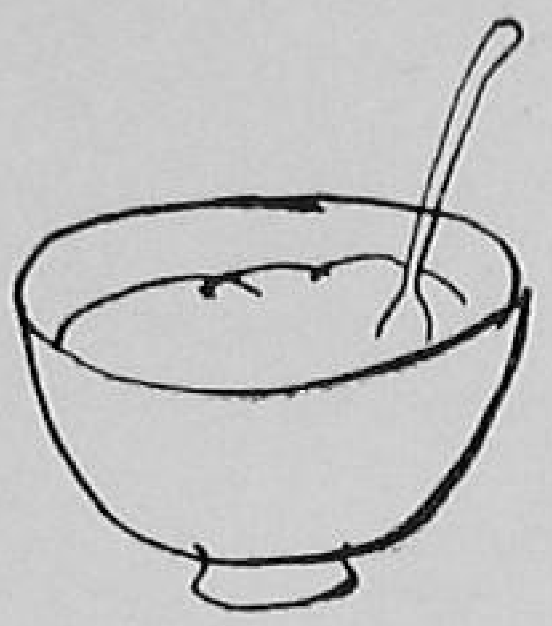
Ingredients :

Maize flour	1 kilogram
Water	2 cups
Ghee	1 tablespoon

Method :

1. Prepare dough of maize flour. As the flour does not have much of sticking quality, only a little water should be added at a time. The dough should be hard.

2. Wet a muslin cloth and spread it on the rolling board.
3. Prepare *chapatis* by hand by pressing the dough with hand on the wet cloth.
4. Bake it on hot *tawa*.
5. Apply *ghee* on hot *roti*.



KHICHRI

Ingredients :

Green maize	.. ..	450 grams (1/2 seer)
Peas *dal*	.. .. ..	225 grams (1/4 seer)
Ghee	.. .. ..	225 grams (1/4 seer)
Onions	.. .. ..	2 (cut fine)

Curry powder; chilli powder for seasoning; salt to taste.
Mixed vegetables (a little each of potato, *parwal*, *lauki*, *torai*, and lady's finger)

Method :

1. Cook pea dal for 20 minutes.
2. Fry green maize till golden brown.
3. Fry onion in a little *ghee* and keep aside.
4. Add fried maize, curry powder, salt and mixed vegetables. Mix well and allow to cook.
5. Add *ghee* (about 1 tablespoon) while cooking.
6. Garnish with fried onion, and serve hot with *ghee*.

PHAJEETA

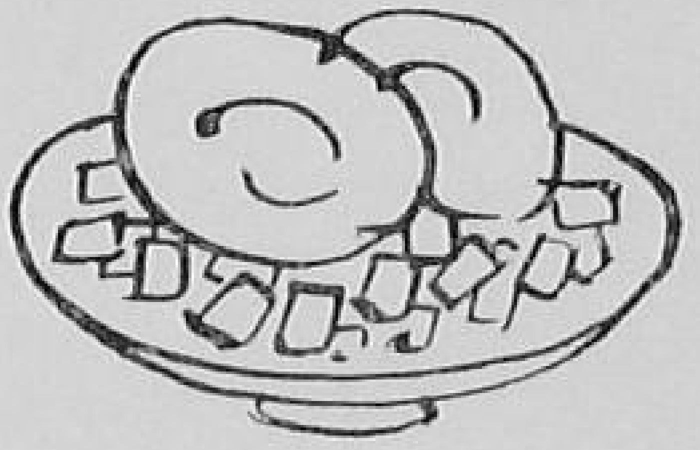
Ingredients :

Green maize seed	.. .. ..	450 grams (1/2 seer)
Green *dhania* leaves (chopped)	..	2 spoonfuls
Green chillies (cut)	.. ..	4
Small onions (chopped)	.. ..	2
Red chilli powder	.. .. ..	1 tablespoon
Turmeric (*haldi*) powder	.. ..	1 tablespoon
Salt	.. ..	2 tablespoons, or to taste
Cooking oil (any kind) or *ghee*	..	2 tablespoons
Lemon for serving	.. .. ..	One or two

Method :

1. Wash and grind the seed into fine paste.
2. Heat oil in frying pan (*karahi*).
3. When oil is hot, add onions, green chillies, *haldi* and chilli powder; mix.
4. When the onions are brown, add the paste and salt; mix well.
5. Pour a little water, just enough to cover the paste.
6. When the water dries up, add *dhania* leaves and scraped coconuts.
Serve it hot with lemon pieces.

It is a fine *nashta* dish. The same can be served also with a main dish.



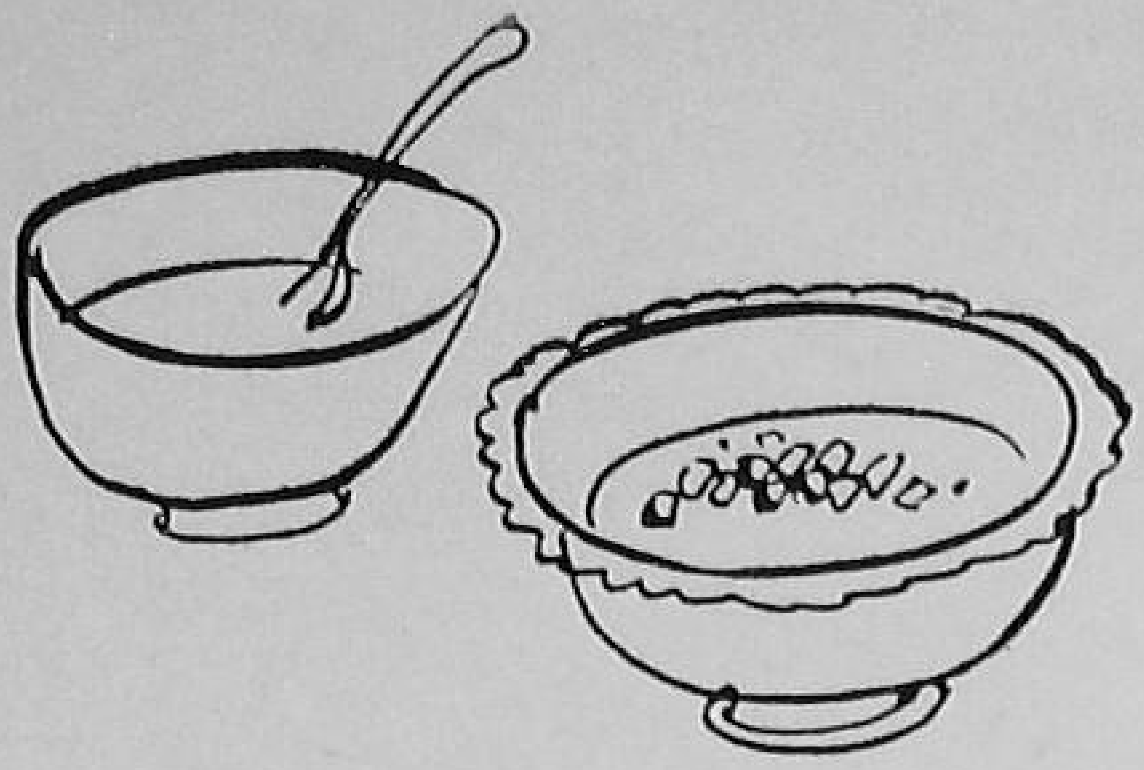
PAKORAS/BONDAS

Ingredients :

Tender cobs (grated)	.. ..	12
Green chillies (finely chopped)	..	4 to 6
Onions (finely chopped)	.. ..	1 or 2
Fresh *dhania* leaves, *amchur*, *haldi*		A little
Salt	.. ..	To taste
Besan	.. ..	30 to 40 grams
Ghee/oil for deep frying		
Water for making dough	..	30 to 40 grams

Method :

1. Mix all the ingredients together (excepting *ghee*) and make a medium dough with water, two or three hours before cooking time.
2. Make balls of the dough mixture and fry them golden brown in deep fat.
3. Serve hot with *chutney*.



DAL AND *KARHI*

Ingredients :

Green maize seed	450 grams (1/2 seer)
Green *dhania* leaves(chopped) ..	2 teaspoons
Green chillies (cut)	4 to 6
Turmeric (*haldi*) powder, red chilli powder, *sarson* seed or *jeera* ..	1 tablespoon
Oil or *ghee*	4 tablespoons
Salt	2 tablespoons, or to taste
Ginger (cut fine)	1 inch pieces
Water	2 kilos

Method :

1. Wash, dry and grind the seed into a fine paste.
2. Heat *ghee* or oil in a brass vessel (*bhagona*).
3. When the oil or *ghee* is hot, add *sarson* seed or *jeera,* turmeric powder, chilli powder, green chilli and ginger.
4. Pour water slowly, allow to boil, add the paste.
5. Stir constantly till it starts simmering.
6. When it becomes thick, add *dhania* leaves and serve in place of *dal*.

Note : Instead of water, use *mattha* or curd and it becomes *karhi*.

CHILLA

Ingredients :

Green maize seed	450 grams (1/2 seer)
Green *dhania* leaves(cut) ..	2 teaspoons
Onions	2
Chillies (green, cut fine)	4
Red chilli powder	
Haldi powder...	1 teaspoon
Salt	2 teaspoons, or to taste
Oil or *ghee*	115 grams (2 *chataks*)

Method :

1. Wash, dry and grind the maize into fine paste.
2. Add *dhania* leaves, green chillies, onion, chilli powder, *haldi* powder, and salt.
3. Add a little water so that the paste can be spread evenly when poured on hot *tawa.*
4. Apply a little oil or ghee on the *tawa ;* pour and spread the paste evenly.
5. Cover it for 3 to 4 minutes.
6. Turn it once and again cover it; apply a little oil again.

   Serve it hot with any *chutney.*

PANCH MAHAL

Ingredients :

Tender milky cobs (grated) ..	18
Powdered clove and cinnamon ..	1 teaspoon
Green chillies (finely chopped)	3 to 5
Chopped green coriander	
Sugar	5 to 6 teaspoons
Haldi	A pinch
Salt	To taste
Milk	2 cups
Ghee	A little

Heat *ghee.* Add *haldi,* powdered clove and cinnamon and chillies. Add grated cobs. Mix well. Cover and keep on slow heat for a minute. Add salt, sugar and milk, and cook till the corn is tender and milk dries up. Remove from fire. Garnish with scraped coconut and coriander.

Serve hot. This is a very popular snack dish.

KACHAURI, SAMOSA AND *PARATHA*

Ingredients :

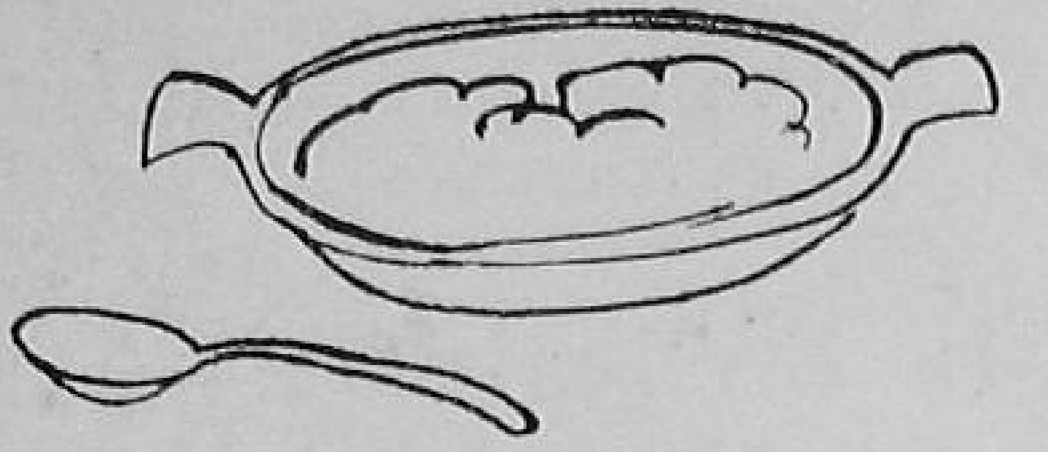
Pitthi and *masala* is the same for these three preparations.

Maize flour	450 grams (1/2 seer)
Peas, potato, cauliflower, green *dhania* leaves and scraped coconut	225 grams (1/4 seer)
Garam masala	1 teaspoon
Chopped *adrak*	2 teaspoons
Green or red chillies	6
Oil for deep frying	

Method :

1. Boil peas, potato and cauliflower and mash them.
2. Put frying pan on mild fire with one tablespoon oil in it.
3. Put in the pan *masala* (scraped coconut, *sambhar* or green *dhania, adrak* and *heeng* and *garam masala,* with salt to taste).
4. Fry the *pitthi* very mildly for further preparation.
5. Prepare the dough with boiled water.

6. Put *pitthi* in the dough balls and prepare your dish of choice, i.e. *paratha, samosa* or *kachauri*.
7. Fy these in deep oil on mild fire.



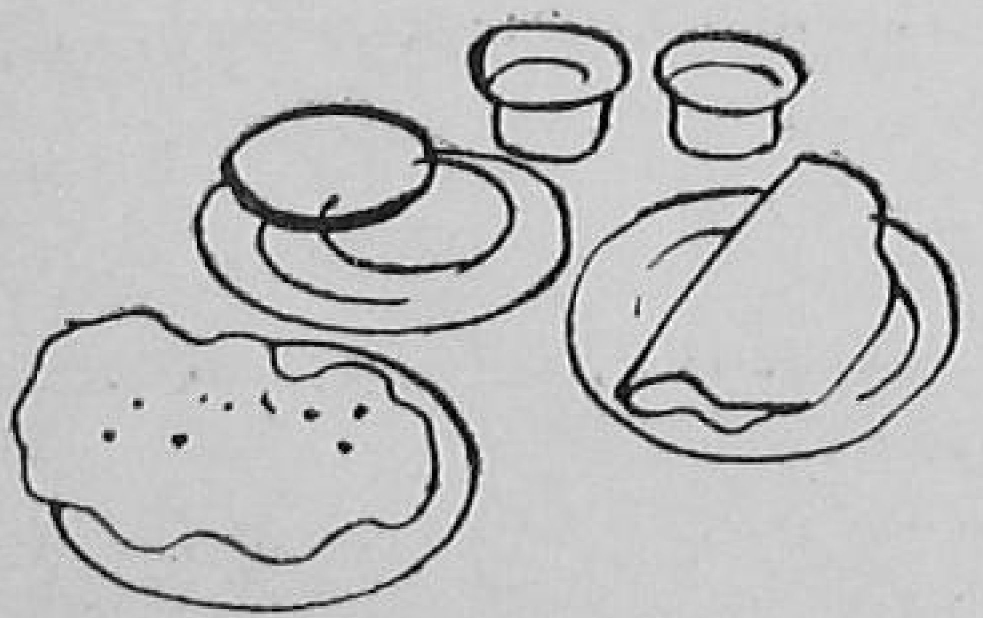
CORN *UPPMA*

Ingredients :

Tender cobs (grated)	12
Onions (finely chopped)	4 to 6
Green chillies	4 to 6
Ginger, coriander, powdered *zeera*, salt, *haldi*, etc., mustard seeds, scraped coconut, sugar (optional)	To taste
Ghee	4 to 6 teaspoons
Milk/Water	1/2 to 1 cup

Method :

Fry onions till slightly brown; add *haldi*, salt, *zeera* and mustard seeds. After a while, add the grated corn and sugar, and stir. Pour in milk/water, and cook a little. Add scraped coconut, chopped coriander and ginger. Serve hot.



IDLI, DOSAI AND *PAPAD*

Ingredients :

Maize *suji*	1/2 kilogram
Urad dal (black gram)	1/8 kilogram
Salt	To taste

Method :

1. Soak the *suji*, and grind it to a smooth paste.
2. Soak *urad dal* overnight. Grind to a paste.
3. Mix the two pastes, adding salt. Beat well. Set the mixture to ferment for 8 hours.
4. Set in containers, and steam like rice *idlis*.

Note : *Dosai* can be prepared by adding extra paste of *urad dal* to the above maize paste.

For *papads* : 1. Steam the above dough (with salt to taste).
2. Pound well and roll out to *papads*. Dry in shade, and store.

LADDU AND *BARFI*

Ingredients :

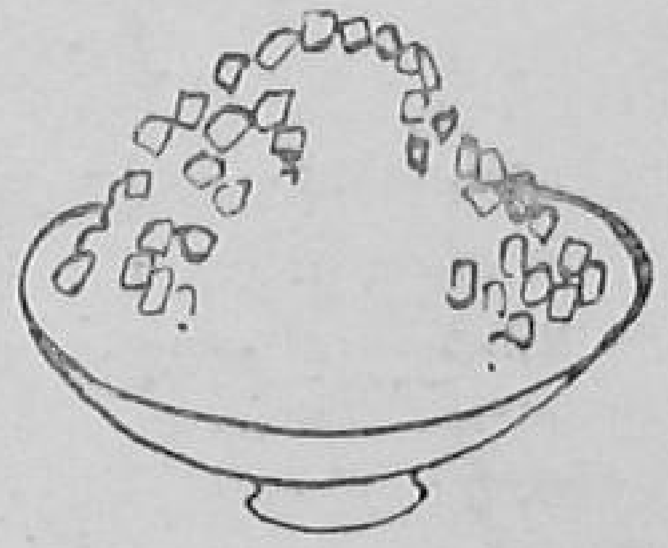
Maize flour	450 grams
Sugar	225 grams (1/4 seer)
Ghee	50 grams (1 *chhatak*)

Method :

1. Melt *ghee* in a frying pan over slow fire.
2. Add flour, and fry it for some time until light brown.
3. Make sugar syrup in a small vessel or *bhagona*.

Test : The syrup, when ready, makes a stringy formation between two fingers.

4. Add flour, mix and roll into balls or *laddus*. The *laddus* can be preserved for a fortnight. If you want to make *barfis*, spread the paste on a *thali* (applied with ghee) and cut into diamond-shaped pieces. For further taste and decoration, add 1/8 seer *khoya*, grated coconut, *chironji* or *pista*. This will make it more tasty.



FRIED MAIZE

Ingredients :

Green maize seeds	1 kilogram
Green chillies (cut)	2
Oil	50 grams (about 1 *chhatak*)
Haldi powder	1 teaspoon
Sugar	2 teaspoons
Chopped green *dhania* leaves ..	2 teaspoons
Salt	To taste
Zeera	1 teaspoon
Garam masala	To taste
Onion (cut fine)	1 (big)

Method :

1. Heat oil in a frying pan on a slow fire.
2. Fry green maize till light-brown, and take it off from the frying pan.
3. Fry onion and add *zeera, haldi, garam masala* and *dhania* (chopped). Add fried maize and salt to taste. Mix well.
4. Serve Piping hot, with cut lime. A little lime juice adds to the taste and fortifies with vitamin C.

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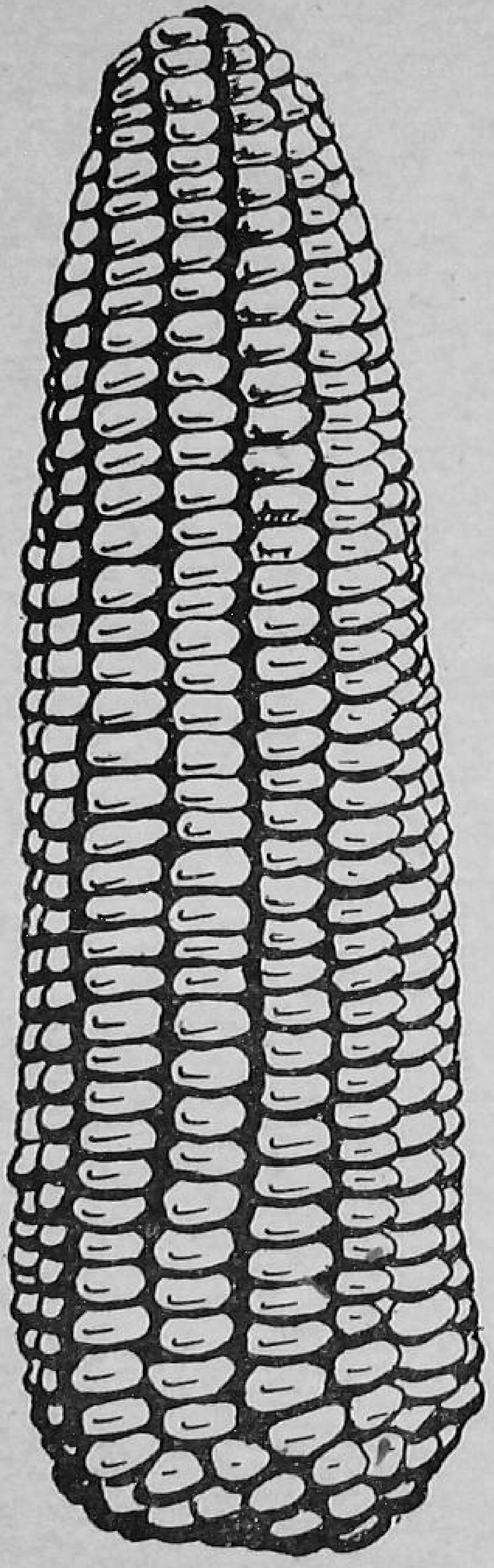

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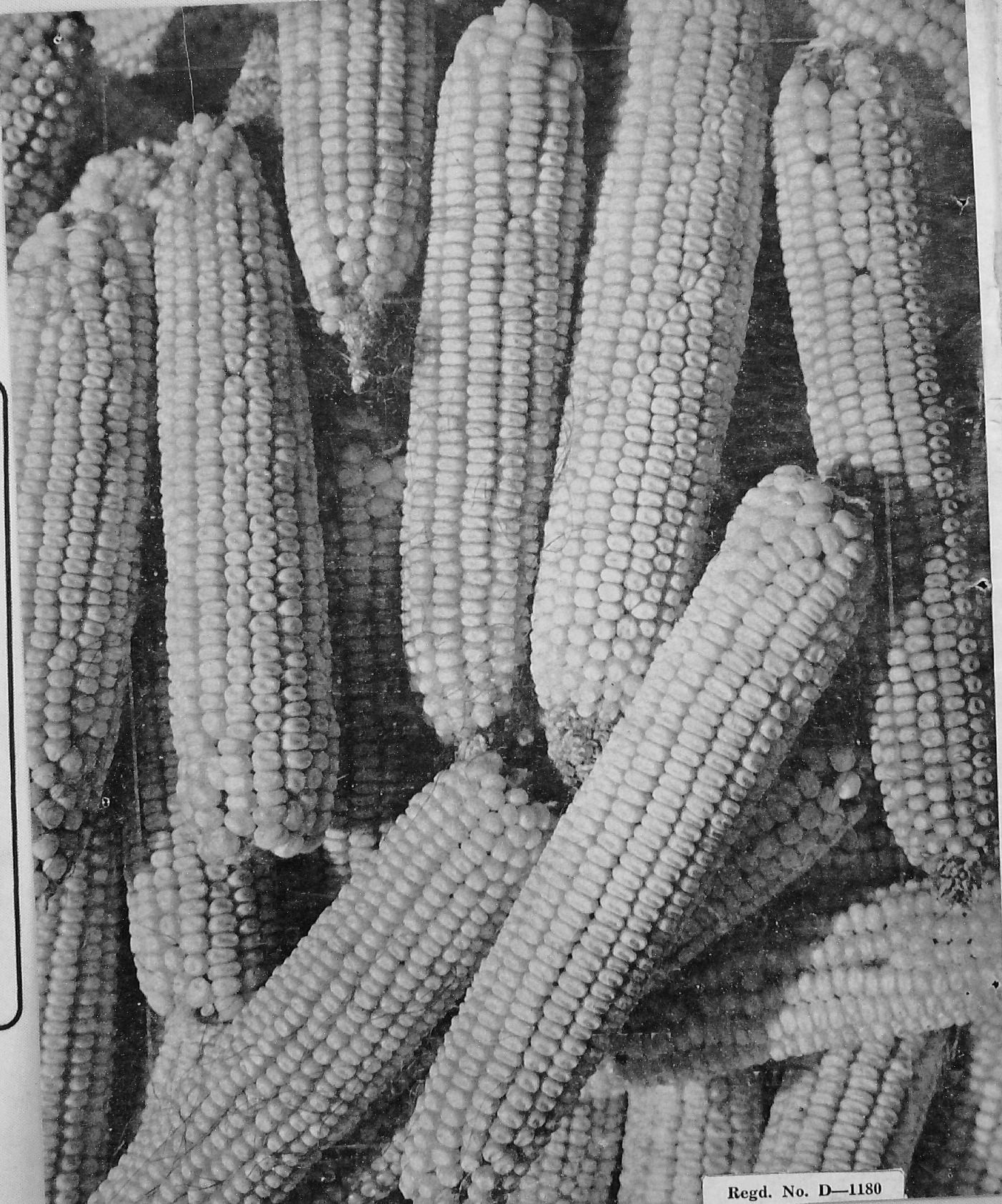

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